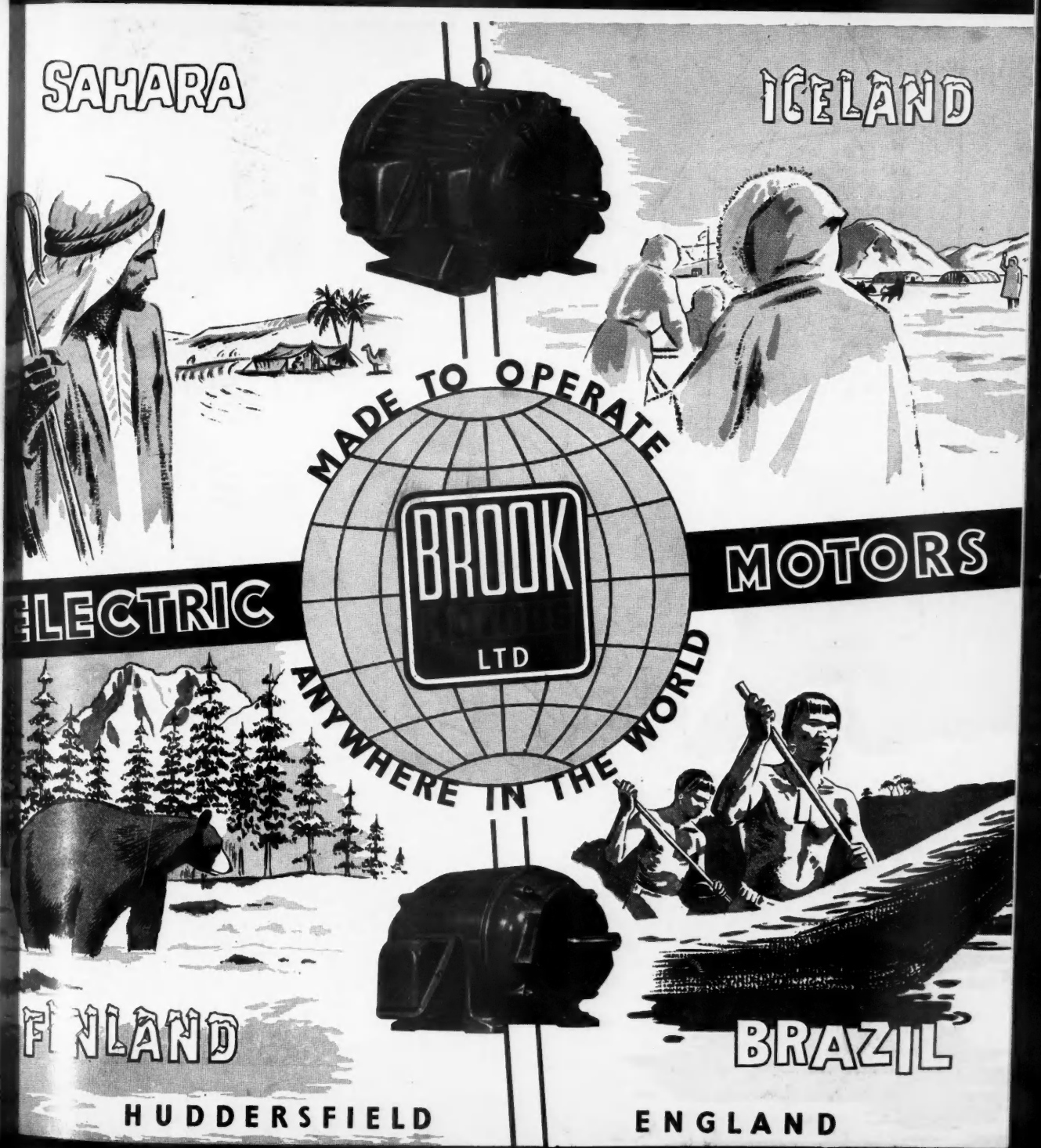
ELECTRICAL REVIEW

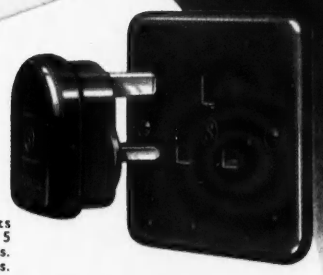


for all domestic switchgear

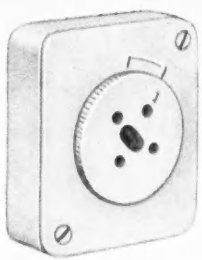
"All Insulated" Consumers' units

Cooker Control Units

Metal Clad Consumers' units



Safety Sockets and Plugs for 5 amps., 15 amps. and 13 amps. ratings



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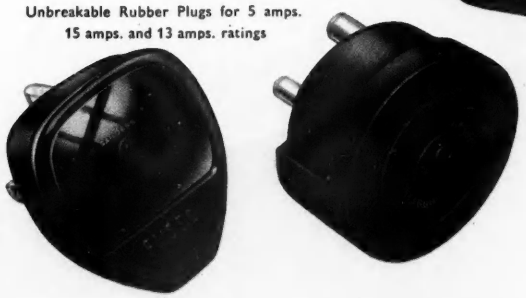

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ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

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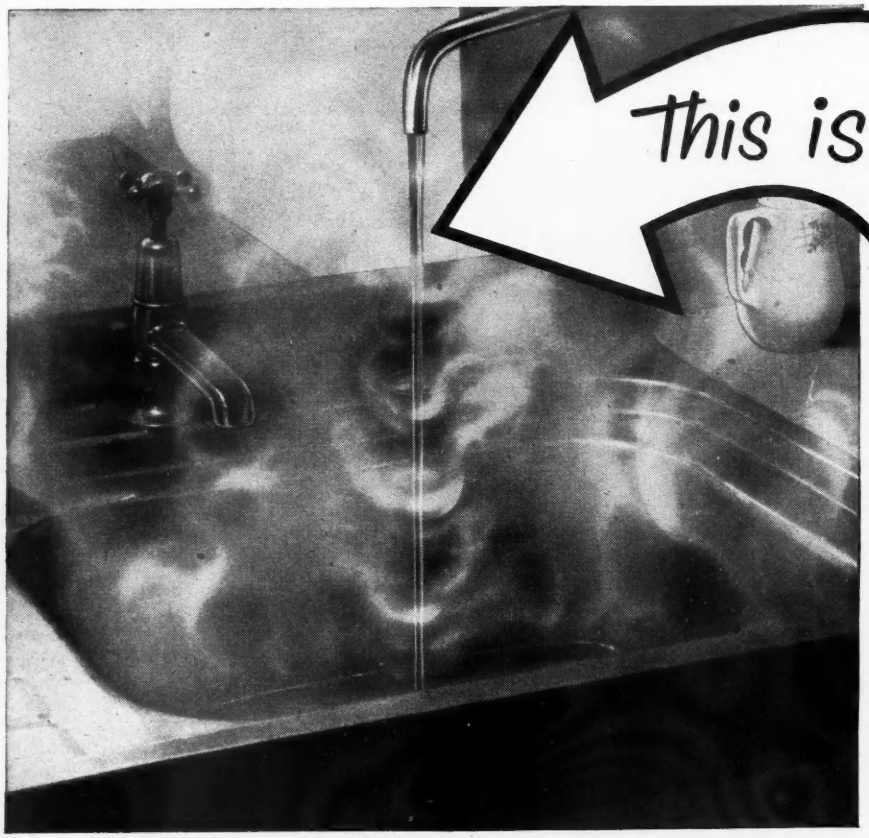

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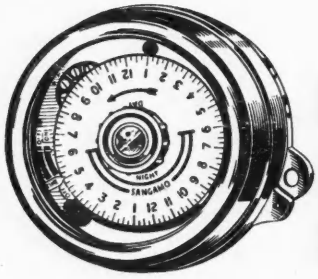

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ELECTRICAL REVIEW

4 January 1957 Vol. 160 No. 1 Established 1872

Brain-Power Economy

NUMERICAL deficiency in man-power includes, as its most serious feature, an even greater scarcity of those qualified to bring into use the potentialities of natural and artificial scientific resources. This scarcity will be increasingly felt in view of the accelerating rapidity of electrical development which is bound up with progress in allied branches of engineering. Many reports have been drawn up since the war on the training of engineers of different categories and it now remains to fit their recommendations to prevailing and expected conditions. That task will not be easy, but the adaptation of the principles laid down will no doubt be hastened by discussions among engineers such as that held recently in Cambridge, which was reported in our 30th November issue. It is not enough to provide good educational facilities and curricula. An even more urgent problem is to attract the very large number of youthful recruits required, remembering that those with a natural bent for engineering will have usually already made up their minds to follow it.

The estimate given at the meeting of the very small proportion of the population that is capable of abstract thought is at first glance disturbing, particularly when related to the competing claims on the services of such men in other walks of life. It lends emphasis to the importance of economy in the use of their abilities, and avoidance of waste of talent through failure on the part of the more centralised administrations of to-day to use it productively or through its employment on tasks which could be just as well performed by those qualified to deal with existing techniques only. Then again the short-term call for high industrial output has to be balanced against the long-term requirement of foreseeing future probable advances in science. An instance is in the nuclear field where the urgency of providing a substitute for conventional fuels has made its demand on brain effort in addition to that needed simultaneously for investigations into the practicable future possibilities of more efficient types of reactors.

The foregoing considerations in no way underestimate the vital importance of the training of the majority having lesser academic potentialities who form the backbone of the engineering profession. Abstract thought may be too abstract for many purposes in industry. In either case, as has come now to be generally recognised, suppleness of mental outlook (which is fostered by some knowledge of what is often termed " cultural " aspects of civilisation) is essential even for material reasons. An engineering background with its factual approach to life should justify ambition to achieve the highest administrative positions, as is commonly found in engineering industries. To engineers of any grade, however, belongs the satisfaction of doing work of obvious social value.

STILL FIRST-CLASS

Recent events in the Middle East have engendered a sorry state of mind in a large section of our people. They are gloomily going around saying that Great Britain is no longer a " great power " and that we must resign ourselves to becoming a second-class nation. But we cannot sustain a population of fifty millions on such a basis and it is as well to have the kind of corrective provided in a letter to *The Times* from Mr. W. Lionel Fraser, chairman of Babcock & Wilcox, Ltd.

Mr. Fraser says that if we review our achievements and our contribution to world affairs we are brought to the conclusion that we are still entitled to rank as a first-class nation. More than half of the world's trade is conducted in sterling and our commodity markets, insurance, shipping, money and exchange markets and the international banking system provide the most efficient service of its kind in the world.

Moreover in engineering, nuclear energy, aircraft design and construction, art, literature and many other spheres we more than hold our own. If we accept an unjust and unfair evaluation of ourselves we shall be in grave danger of losing our resolution and with it the vision and creative ideas which the times demand.

SOUTHEND ELECTRIFICATION

The extension of the Eastern Region's electrification from Shenfield to Southend, officially opened last week, completes the major London-Shenfield-Chelmsford-Southend electrification scheme of the British Railways which was started some years ago.

This scheme employs track distribution at 1,500 V d.c., and in view of the decision to employ 25 kV 50 c/s a.c. track distribution for future schemes we imagine that this will be the last use of d.c. track distribution in this country, apart from the extensions of the Southern Region system. It must be remembered, however, that although the Eastern Region scheme is an all-d.c. scheme, that is d.c. is employed both for track distribution and tractive power, d.c. motors will still be used for the national plan and the 25 kV a.c. supply will be converted by rectifiers on the locomotives. Provision has been made to employ the nationally adopted 25 kV system for the Eastern Region lines at some future date. Compared with the larger national scheme this Shenfield-Southend section is a small contribution to electrification, but it was planned long before the British Transport Commission's modernisation scheme.

MISGUIDED ECONOMY

Complaints about low voltage in many parts of the country continue and there are still many breakdowns. At the same time some Electricity Boards often appear to be reluctant or unable to connect new consumers. All this indicates that the need for the reinforcement of distribution systems is becoming more pressing. The disabilities from which the Boards are suffering arise from the " credit squeeze," but even before that they were unable to keep up with the demands on what were often outdated systems. Now they have been told that financial restrictions must not be allowed to impede rural electrical development. That is no doubt right but this work eats up a disproportionate amount of available capital, to the further detriment of urban distribution. At a time when, in spite of credit restrictions, a great deal of less essential work is being carried out it is utterly wrong that the electrical service, because it is nationalised and therefore more easily got at, should be cramped in this way.

"BEYOND THE MOTOR COUPLING"

This was the title of an article by Mr. A. W. Leadbeater published in the *Electrical Review* of 21st December. It dealt with many aspects of power transmission problems which are, or should be, the direct concern of the works and installation engineer, to say nothing of the motor manufacturer who must, of course, be involved in the design stage. Both the article and a letter on the subject in this issue show clearly how very tightly the electrical and mechanical aspects of any drive are interlaced.

There has also been some uncertainty as to who is responsible for the power transmission scheme of any machine or factory drive. We contend that whether or not it is the specified responsibility of the works electrical engineer he must be involved in the mechanical transmission problems because such aspects as speed reduction ratios often dictate the type of motor employed. We suppose that this controversy will go on for all time but whatever he is in name the works electrical engineer must face up to the power transmission problems involved.

METAL OUTLOOK

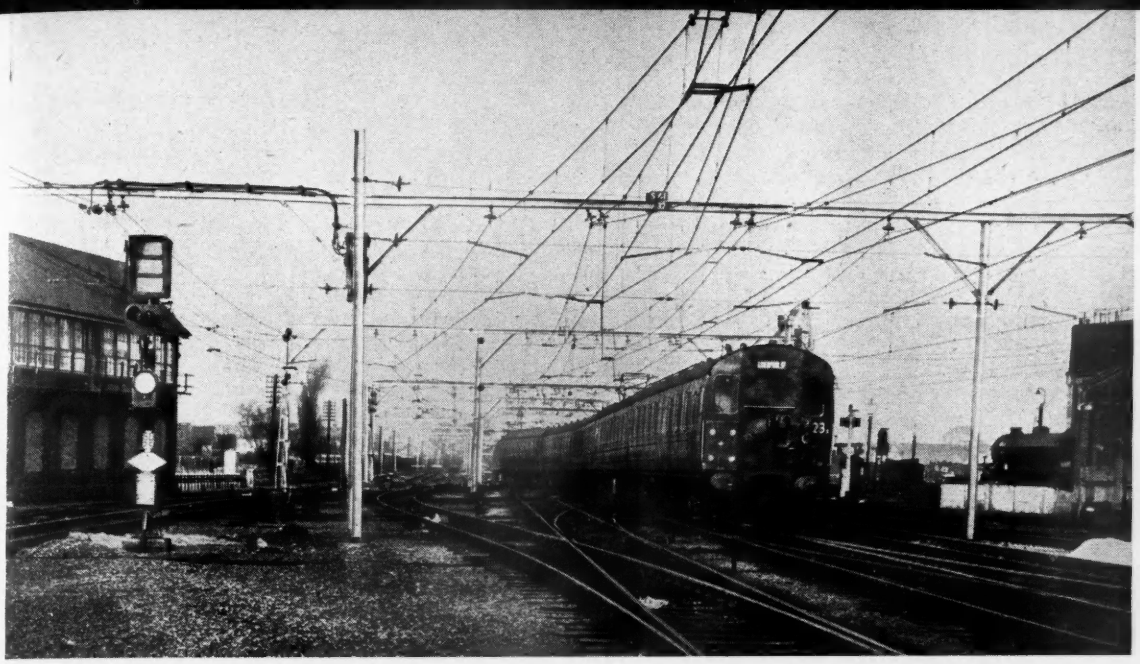
In March, 1956, the price of copper attained a new high level, £437 a ton, but thereafter there was a swift decline and at the close of the year it was around £280 a ton. The high price resulted in many endeavours to substitute aluminium for copper although the aluminium price also rose during the year.

It will be seen from our annual survey on page 21 that the indications for the year now beginning are that prices of copper, aluminium, lead and zinc will be comparatively stable; in the case of tin the position is less certain in spite of the International Tin Agreement which has led to the creation of a buffer stock to even out the price.

CLEAN AIR

There are profound implications for the electrical industry in the coming into force of a substantial part of the Clean Air Act, 1956, as from 1st January. Most of the Act's provisions are directed against the emission of smoke and grit from industrial establishments. The owners of many such establishments may find (or be persuaded to agree) that in order to comply with the new requirements their best course is to replace old plant by electrical methods.

Where a local authority declares its district or part of its district to be a " smoke control area " it may require the owners or occupiers of private dwellings to adapt their cooking or heating arrangements so as to avoid contraventions of the regulations. In such cases the authority (subject to certain conditions) must meet part of the cost. Here again it will often be found that the adoption of electric cooking and heating is the best way of conforming to the rules.



ELECTRICAL REVIEW 4 JANUARY 1957

Shenfield-Southend Electrification

Official Opening of Final Section of Liverpool Street Line

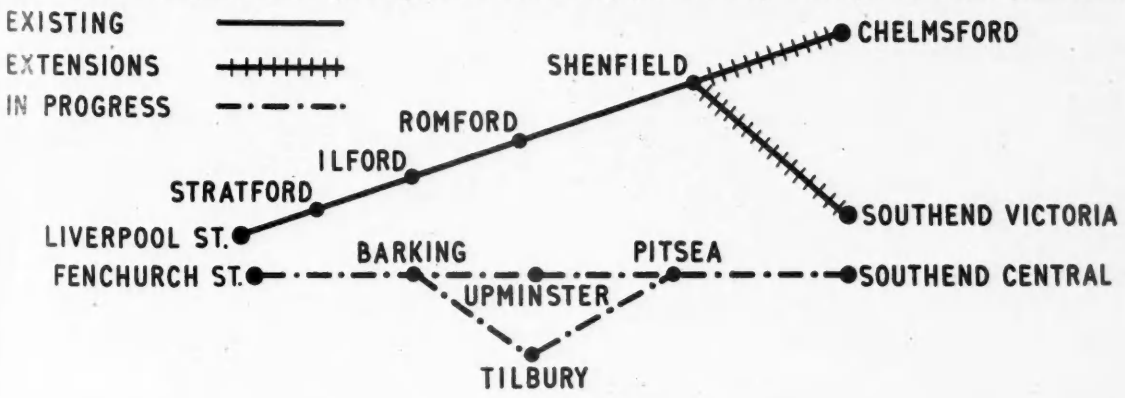
THE British Railways electrification scheme linking London (Liverpool Street), Shenfield, Chelmsford and Southend, which was started some years back was completed with the official opening of the final section, i.e. Shenfield to Southend, last week by Sir Reginald Wilson, chairman of the Eastern Area Board, British Transport Commission, and electric train services between London and Southend were started on Monday last.

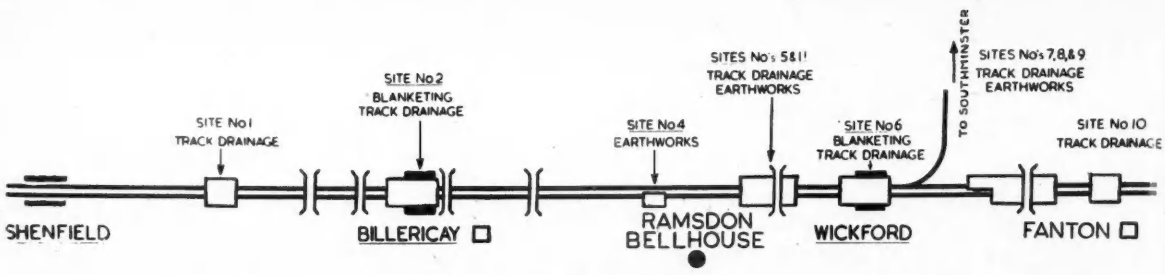
The work of electrifying the section began in the summer of 1955. The section is an extension to the existing London to Shenfield electrified line which was completed for passenger service in September, 1949, on the 1,500 V d.c. overhead system, provision being made for conversion of the whole section to the new 25 kV a.c. system recently adopted by British Railways. It is a two-track branch line diverging from the main East Anglian line at Shenfield, with about 21 route miles and 49 single-track miles.

There are three substations along the line, at Ramsden Bellhouse, Rayleigh and Prittlewell. Electrical energy at 33 kV, three-phase, 50 c/s, is transmitted directly by a single feeder owned by the Eastern Electricity Board to Ramsden Bellhouse substation, about seven miles from Shenfield. A similar arrangement also applies to Rayleigh substation, which is about 14 miles from Shenfield, except that in this case there is a run of about ¾ mile of e.h.v. feeder cable which is part of the railway distribution system between the point of supply and the substation. In the case of Prittlewell substation, about 20 miles from Shenfield, the Eastern Electricity Board again supplies the substation directly, but with duplicate feeders at 33 kV. Ramsden Bellhouse is a single unit substation with one 2,000 kW mercury-arc rectifier. The equipment also includes one 500 MVA single busbar metalclad switchboard having one 400 A rectifier breaker and duplicate 30 kVA plug-in auxiliary transformers. The 1,500 V d.c. switchboard has one 2,000 A high-speed circuit-breaker and four 1,600 A d.c. high-speed circuit-breakers.

Rayleigh substation is identical with Ramsden Bellhouse, except that the h.v. switchgear is rated at 750 MVA

Above: Electric train leaving Southend-on-Sea (Victoria) station. Below: Route map of the London-Shenfield-Chelmsford-Southend electrification scheme





The new Shenfield-Southend section showing the supply substations ● and the track sectioning cabins □

and there is only one plug-in auxiliary transformer. At Prittlewell substation the only difference from Ramsden Bellhouse is that the e.h.v. switchgear is rated at 750 MVA, but in this case it is a double unit substation. Three-track sectioning cabins, each with four supervisory controlled high-speed circuit-breakers, are located at Billericay, Fanton and St. Mary's, each being approximately midway between the existing Shenfield substation and the three new substations mentioned above. Each of the substations and the track sectioning cabins is supervisory controlled from the existing electric control centre of the Liverpool Street-Shenfield line at Chadwell Heath. The British Thomson-Houston Co., Ltd., was responsible for the entire electrical installations in the substations.

The overhead line equipment is similar to that provided on the Liverpool Street-Shenfield section, but the total copper equivalent is 0·6 sq in per track instead of 0·75 sq in. The main and auxiliary catenaries are of hard drawn copper and the contact wire is of cadmium copper alloy.

Span wire registration has been adopted instead of mechanically independent registration, and the insulators are of the cap and pin type. The line is sectioned electrically, not only at the substations and track sectioning cabins, but also by hand-operated switches at certain strategically placed overlap spans.

It was necessary to isolate the signalling equipment from the effects of stray current from the traction supply, and for this purpose the Siemens & General Electric Railway Signal Co., Ltd., has supplied and installed 169 a.c. track circuits, of which 111 are double-rail with impedance bonds. This company also supplied the associated power cable for 650 V a.c. and four telecommunication cables—one eight-pair and three single-pair. All existing search-light signals have been adapted for a.c. control through transformer-rectifier units, and similar arrangements have been made for d.c. lever locks at ground frames.

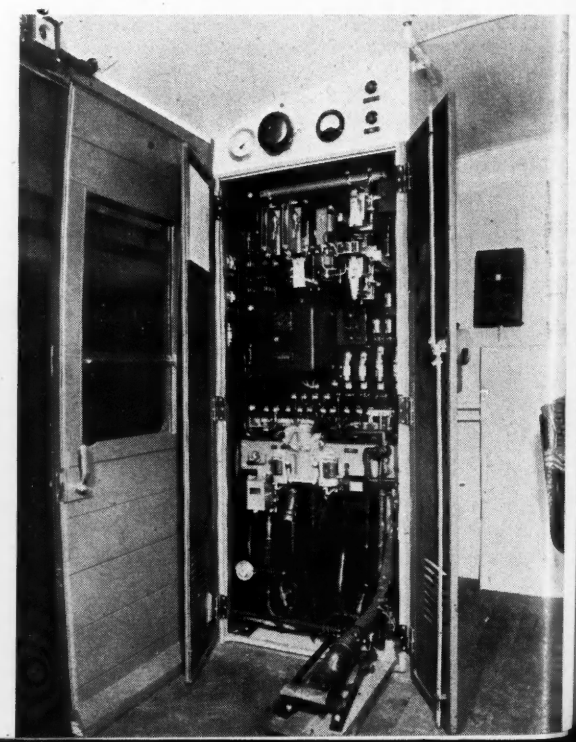
Multiple-Unit Coach Sets

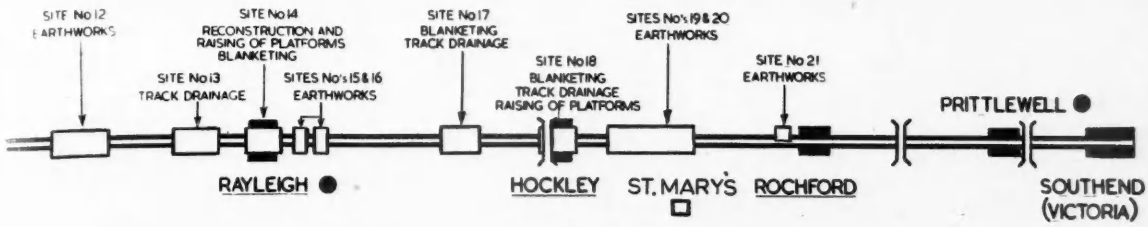
Electrical equipment for the 32 all-steel four-coach multiple-unit sets built by British Railways at Eastleigh has been supplied by the General Electric Co., Ltd. Each unit consists of a driving trailer, motor coach, trailer and second driving trailer, providing in each unit 19 first-class and 344 second-class seats. Of the latter, 140 are in open type vehicles with central passageway and the remainder in compartment type coaches. First-class sections of compartment coaches have side corridors. The combination of compartment and open type stock, with two classes, has been adopted for these trains because of the nature of the traffic on the Southend line, which consists both of regular business travellers and holiday visitors with luggage. The equipment has been designed to operate a 60-minute limited-stop service.

Current is collected by a pantograph on the motor coach and passes to two overload relays, one in each leg of the four-motor equipment. The two axle-hung, nose-suspended motors in each bogie are connected permanently in series, control being by series or parallel connection of the two pairs, with bridge transition. Either

Interior of driver's compartment in a driving trailer

L.v. equipment cubicle in motor coach van compartment





pair of motors can be isolated by means of hand-operated motor cut-out switches which also make the necessary modifications in the control circuit. Continuous and one-hour ratings of a unit are as below:—

	Full field	Weak field
Continuous rating of unit	632 h.p.	696 h.p.
One-hour rating of unit	800 h.p.	880 h.p.

The motors are self-ventilated and take in cooling air direct through protected inlets on top of the frames.

Contactor Control Equipment

The electro-pneumatic contactor control equipment, with the relays, and reversers and motor cut-out switches, is accommodated in three cases mounted in the motor coach underframe, and is operated from master controllers in the driving trailers, there being no driving compartment in the motor coach because of its intermediate position in the unit. A shunting notch and three running notches are provided, the former having a rating to permit shunting movements and other slow running with all resistance in circuit. Movement of the controller handle to the series, parallel or weak-field positions initiates automatic acceleration to the selected notch. One section of resistance is in circuit only on the shunting notch, its subsequent elimination assisting in the balancing of the circuit for the bridge transition. There are nine resistance notches in the automatic progression to full series and four to full parallel. During acceleration in parallel the corresponding sections of resistance in each motor branch are coupled together.

There is one weak-field running notch, but this is reached through an intermediate step in which a portion of the motor fields is diverted by resistances. In the final step the fields are weakened by tapping. To reduce the demand when taking the weak-field steps, and also to keep the current peaks within reasonable limits, a separate current limit relay having a lower drop value than the main relay is used.

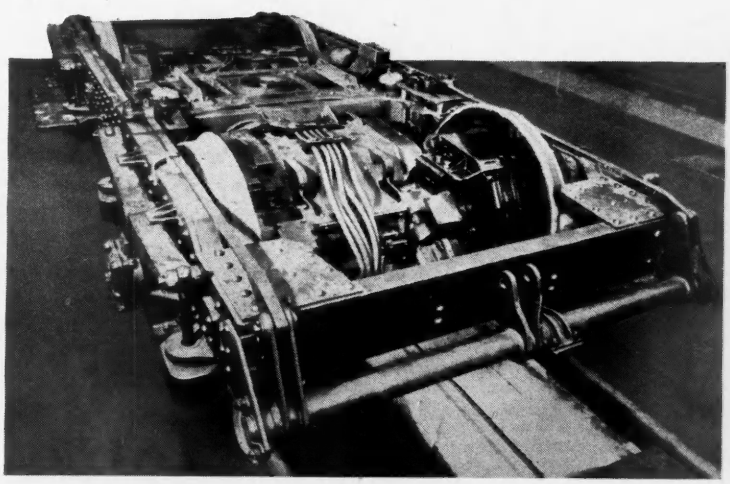
Two rates of acceleration can be selected by alternative "forward" positions of the reverser handle. The normal rate corresponds to 1·1 m.p.h./sec, while the lower rate, intended for use in greasy rail conditions, is 0·85 m.p.h./sec. When the higher rate is selected, the drop values of the main and weak field current limit relays are modified by means of shunt coils. Operation of an overload relay causes a protective resistance to be brought into circuit before the current is broken finally by means of a line switch.

The supply to the auxiliary motor-generator set, the Westinghouse compressor and coach heater lines is taken from the pantograph through a 60 A main auxiliary fuse which provides back-up protection should the compressor contactor, m.g. fuse or heating fuse fail to clear. Fault currents in the auxiliary machines are limited by a protective resistance.

The l.v. generator is rated at 9·5 kV and serves, under the control of a carbon pile voltage regulator, the control circuits, battery charging, train lighting and water heating. Series turns are provided on the voltage regulator to give an overall decompounding characteristic so that the voltage is reduced and the charging current restricted if the battery is in a low state of charge.

Pantograph Operation

A cubicle containing the majority of the l.v. control equipment is housed in a van compartment in the motor coach. A foot pump for raising the pantograph is also housed in the cubicle and can be hinged down into the operating position after the door has been opened. When the pantograph is raised by the pump, the auxiliary relay which completes the circuit for closing the compressor and m.g. contactors is set by hand, so that the machines start as soon as the pantograph touches the overhead line. When air is available, however, the pantograph is raised by pressing the "panto up" push-button in the driving trailer, this action closing the auxiliary relay electrically. On operating the "panto down" push-button in the driving trailer, the auxiliary relay is tripped; its contacts de-energise the heater, m.g. and compressor contactors, so that the possibility of breaking current at the pantograph pan is precluded.



A motor bogie of the new multiple-unit stock for the Liverpool Street to Southend (Victoria) service

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

THE problem of testing the dielectric characteristics of cables at service temperatures, for example, 65 deg C, as stipulated by B.S. 480:54, presents some difficulties of an economic character, since the obvious method of obtaining the temperature rise by current heat is wasteful in energy if active power is used, and technically almost impossible with reactive power. However, as in circuit-breaker testing, methods which might be called synthetic may be devised, and the author presents four suitable circuits in which the heating current is supplied by a separate l.v. source, either by a special heating transformer (of which the tested cable itself may constitute the secondary winding) or by a d.c. generator. According to the author, these variants render the temperature measurements rather difficult (with a.c. heating) or require elaborate insulation of heating and measuring equipment.

A more convenient set-up was devised in which the conductor of the cable is kept at earth potential and its lead sheath is raised to the testing voltage. In this way a normal high-current transformer, supplying d.c. through solid rectifiers, may be used for the heating up, and neither the transformer nor Schering bridge used for the tan δ measurements needs any special and costly h.v. insulation. The temperature measurement is conveniently carried out by comparison of the resistance of the conductor with a standard resistance in a Thomson bridge. In the case of three-core cables the core tested is heated by d.c. and the other two by a.c. (not being connected to the Schering bridge). Experimental results obtained in the new testing circuit on different types of cables and at temperatures up to about 110 deg C are presented and discussed.—"A Simple Method of Determining the Dielectric Characteristics of Heated Cables," G. Buse, *E.T.Z.(B)*, Vol. 8, No. 7, pp. 275-279, 21st July, 1956, in German.

Corrosion Calculations

Prevention of corrosion is obviously better and probably in most cases cheaper than corrosion protection, but an absolute prevention is not always possible and a compromise will then have to be found and adopted. This means minimising possible corrosion effects, which has to be done on the projection stage of the threatened pipe or cable lines or other buried structures. The problem consists in determining, at least approximately, the "critical" minimum distance between corrosion source and buried structure, and the surface density of the leakage current of the structure (which is positive relatively to the surrounding soil).

The most important case is the approach between electric traction systems and cable or pipe lines. This is treated in the first example given in the paper for parallel approach and for crossing of the lines, the second dealing with the effects of d.c. transmission lines on buried structures. Further sections deal with the effects of structures with cathodic protection on neighbouring unprotected buried structures and the interaction of cable lines with pipe lines with cathodic protection. In the latter case a numerical example is worked.—"Calculation of the Danger of Electrical Corrosion to Buried Metal Structures," L. D. Razumov, *Elektrichestvo*, No. 9, pp. 67-73, 1956, in Russian.

Rheostatic Braking

Under certain conditions it is possible to stop an electric train completely by application of the rheostatic brake alone without the aid of mechanical ancillary brakes. The efficiency of the rheostatic brake in this respect is greatly increased by reducing the resistance in the braking circuit and operating with heavy braking currents. The residual resistances in the braking circuit should therefore be reduced to the minimum where rheostatic braking is intended as the main and exclusive method of stopping the train.

This proposition is proved theoretically and demonstrated experimentally by the author, it being found that the main condition for the full efficiency of rheostatic braking is to avoid the existing danger of the braking current dropping to zero at a certain critical speed, which often happens in the conventional braking circuits. It is shown that the circuit can easily be adjusted to obviate this danger and then the experimental $i=f(v)$ curves are in good agreement with the theoretical curves calculated by the author's method. The latter is also suitable for investigations of the current variations in rheostatic braking circuits and the applications of the principle are by no means confined to traction motors, but are equally useful for other drives using series motors.—"The Final Phase of Rheostatic Braking," V. E. Skobelev, *Elektrichestvo*, No. 9, pp. 73-78, 1956, in Russian.

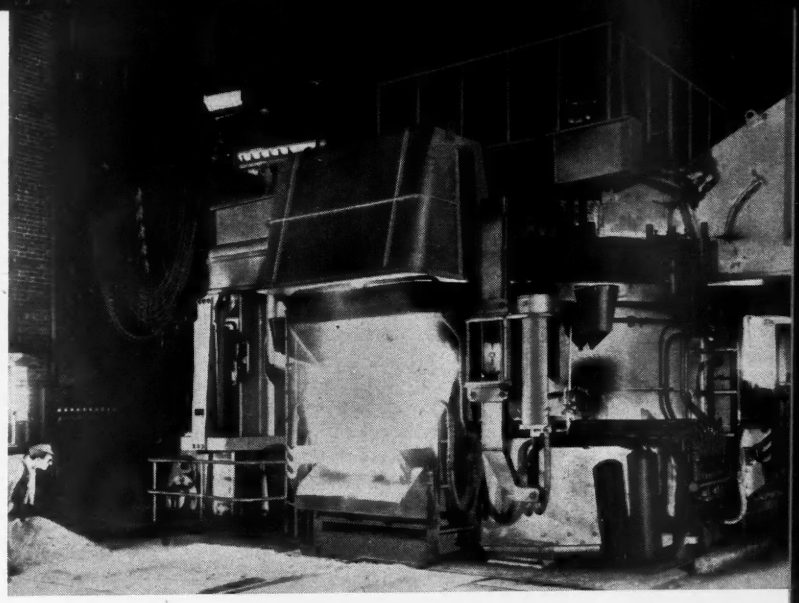
H.V. Testing Stations

The development of h.v. cables, as of any other class of electrical equipment, has to be guided by technical and economic considerations, based on a multitude of ascertainable data, which calls for even more elaborate testing installations. The tests to be carried out may be divided roughly into the groups of breakdown-strength tests, tests of limiting thermal stresses and of resistance against ageing of the insulation (in the widest sense of the term).

The testing programme will obviously vary widely according to the type (compound-filled, gas-pressure or oil-filled) of cable, voltage, power rating, etc. These programmes are outlined in the introduction of the article, before the methods of type and routine tests and the installations for carrying them through are described in greater detail.

The Siemens H.V. Laboratory is probably one of the most up-to-date establishments of its kind and is provided with installations for tests at the commercial frequency up to 1 MV, 2 MVA, d.c. tests up to 2 MV and impulse tests up to 2·5 MV, 70 kW. The 50 c/s testing voltage is supplied by two 500 kV testing transformers, the d.c. testing voltage by a Greinacher voltage-multiplier circuit, and the impulse voltage by a five-stage Marx surge generator. This heavy equipment is naturally supplemented by facilities for all the types of technological and physico-chemical tests required.—"H.V. Testing Stations and their Tasks in the Siemens Cable Works, Berlin," O. Gasser, *Siemens-Z.*, Vol. 30, No. 11, pp. 525-534, November, 1956, in German.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.



60-ton Birlec furnace fitted with B.T.H. electrode regulator, at Samuel Fox, Stocksbridge, near Sheffield

Improved Method of Arc Voltage Measurement

By O. S. STEELE, B.E.(Elect.)*

ARC FURNACE CONTROL

IT may not be generally realised that on large arc furnaces, and to a lesser extent on the smaller furnaces, there is a large voltage drop between the transformer bus and the arc due to the reactance of the flexible cables, the electrode arms and the electrodes themselves. This reactive drop makes it difficult to obtain the correct arc voltage for control purposes.

The method of control adopted on most modern arc furnaces[1] is to maintain constant arc impedance by comparing the voltage signal, obtained by rectifying the voltage across the arc, with the current signal which is obtained in a similar manner from the arc current. In practice, however, it is difficult to measure the actual arc voltage, and this is generally assumed to be the same as the voltage existing between the transformer bus and the furnace shell. While this assumption is close enough when the furnace is operating normally, it is not sufficiently accurate when the power factor is low, i.e. when striking the arc or during a "cave-in."

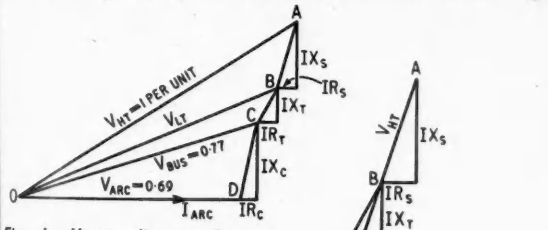


Fig. 1.—Vector diagram for arc furnace under normal operating conditions

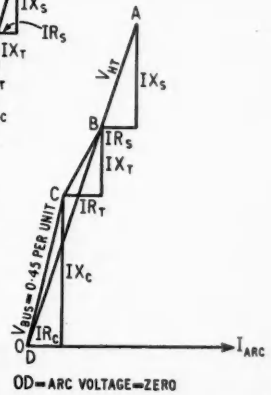


Fig. 2.—Vector diagram for arc furnace under short-circuit or "cave-in" conditions

It might occur to the casual observer that the voltage signal leads should be connected to a point nearer the arc than the transformer bus—on the electrode arm or clamps for example. As most furnaces are arranged to tilt in order to pour the molten metal out and the roof, including the electrodes, of some furnaces swivels in order to allow recharging of the furnace, it is only possible to bring the leads away from the furnace via the electrode arm and the flexible cables. The voltage signal leads would therefore have to be in close proximity to the parts carrying the heavy current and consequently would have a voltage induced in them. This induced voltage, which is nearly equal to the reactive drop in the heavy current conductors (the flexible cables and the electrode arm), is added to the arc voltage so that the vector sum of the two is almost the same as the busbar voltage and little advantage is therefore gained by this arrangement.

The vector diagrams show the relationships between the voltages under normal conditions (Fig. 1) and under short-circuit conditions (Fig. 2). Both diagrams are drawn on a per-unit basis and show the type of diagram which might be drawn for a large arc furnace system. On each diagram vector OA represents per-unit h.t. voltage and AB the h.t. impedance volt drop so that OB is the l.t. induced transformer voltage. Vector BC is the transformer secondary impedance volt drop and OC the voltage between the transformer bus and the furnace shell, which we shall call the voltage signal. The voltage drop between the transformer busbars and the arc is shown by vector CD and the arc voltage by OD. It will be seen that when the power factor is normal, say about 0·85, there is little discrepancy between the busbar voltage and the actual arc voltage.

When a "cave-in" occurs the electrode current rises to a maximum depending on the total circuit impedance, this being generally 35 to 65 per cent according to the size of the furnace. The impedance voltage drops are therefore increased in proportion to the increase of current, and the power factor drops to 0·25 or 0·3. When this occurs the arc voltage is zero and yet the voltage signal as obtained from the busbars is not zero since it includes the voltage drop in the flexible cables, the electrode arm and the electrodes. The net result is that maximum electrode speed is not attained at the very time when it is most needed.

From the above discussion it is quite evident that some method of measuring the actual arc voltage is desirable if the highest efficiency is to be obtained with modern methods

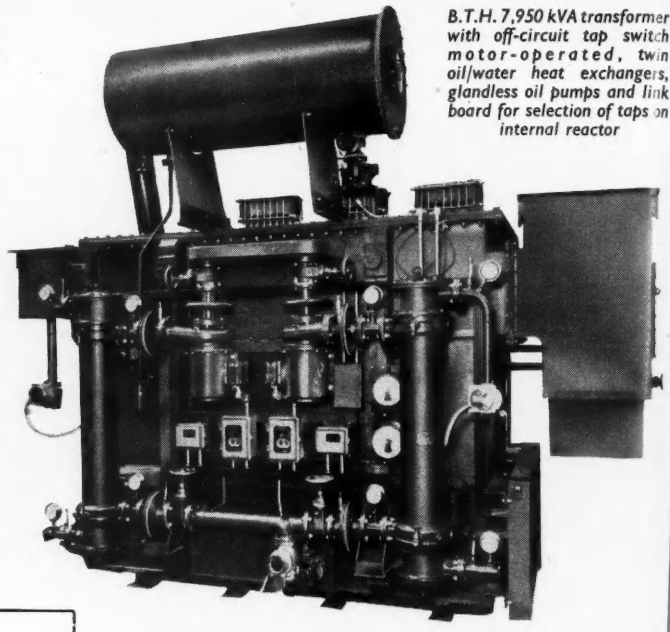
* B.T.H. Industrial Engineering Department.

of electrode control which depend on "proportional control."[2] An improved method of obtaining the correct arc voltage for control purposes is shown in Fig. 3.[3] It could be called voltage compensation because a voltage component equal and opposite to the reactance drop in the flexible cables is added vectorially to the busbar voltage to give a close approximation to the arc voltage.

One method of obtaining the correct signal is to add a voltage, equal and opposite to the reactance drop between the transformer bus and the arc, to the signal voltage taken between the transformer bus and the furnace shell. The existing current transformers may be used to supply a voltage component proportional and opposite to the reactance drop in the secondary circuit between the busbars and the arc. This voltage component, when added vectorially to the voltage signal obtained from the busbars, gives a close approximation to the arc voltage.

This method of control was used for a large arc furnace which was supplied from a 15,000 kVA transformer. The reactance voltage drop[4] on the secondary side of the furnace transformer was approximately 75 V at full load and about 120 V at maximum current, there being over 60 per cent reactance in the furnace supply circuit. In actual practice each of the current transformers on the secondary side of the furnace transformer supplied a reactor inserted in the voltage signal circuit through a matching transformer (which was used for convenience in design). At the same time, because of the existing circuit parameters, it was found desirable to cancel out the voltage drop in the reactor due to the current flowing in it from the voltage signal circuit and this was accomplished by connecting a condenser in series with the reactor and the lead from the transformer busbar.

Tests on the equipment revealed that when a "cave-in" occurred, the voltage signal as used for control purposes was reduced to 15 V by the addition of this equipment whereas it had previously been 120 V instead of the ideal of zero volts. The performance was consequently much improved, the electrodes quickly reaching maximum raise speed and generally clearing the overload before the breaker had time to trip.



B.T.H. 7,950 kVA transformer with off-circuit tap switch motor-operated, twin oil/water heat exchangers, glandless oil pumps and link board for selection of taps on internal reactor

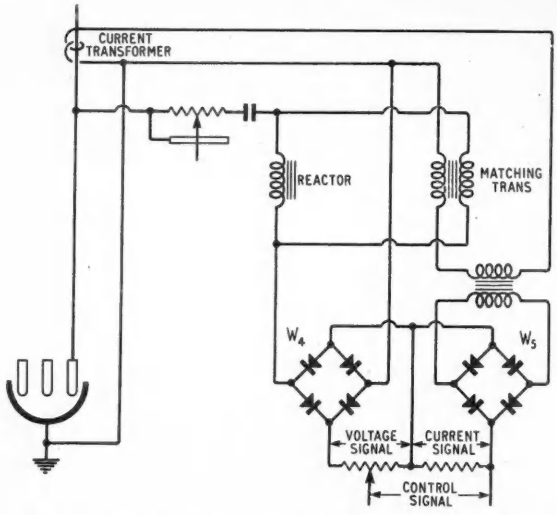


Fig. 3.—Simplified control diagram for arc furnace regulator incorporating voltage compensation for reactance voltage drop in flexible cables, electrode arm and electrode (patents pending)

The increased accuracy of this method of measuring the arc voltage greatly improves the performance of the regulator. In particular, the speed of the electrode is much higher when a "cave-in" occurs and a closer approximation to "proportional control" is obtained. The method also results in less frequent tripping of the transformer circuit-breaker so that maintenance should be substantially reduced.

REFERENCES

[1] *Electrical Review*, 30th September, 1955, "Electric Arc Furnaces."

[2] Proportional control is the term generally used with reference to arc furnace regulators to indicate that the speed of the electrode is proportional to the error or the amount by which the arc impedance departs from its correct value. It largely eliminates the effect of inertia on rotary control systems since the electrode slows down as the error is decreased, and therefore there is less likelihood of overshooting and consequent extinction of the arc.

[3] Brit. Pat. App. No. 31099/55.

[4] When measuring the voltage the voltmeter leads must be taken out at right-angles to the flexible cables and the electrodes in as large a loop as is practical so as to include as much as possible of the flux generated by the heavy current; otherwise the voltmeter reading will be much too low. Alternatively some other method may be adopted which will cancel the induced voltage due to the electrode current.

Meter Bearings

IN an interim report published by the Electrical Research Association (T/T49) a summary was made of experiments on pivot and jewel combinations in relation to the debris formed in the bearings due to wear, and in furtherance of this work an investigation has been carried out on pivots of osmium-rhodium obtained from the Sangamo Electric Co. in the U.S.A. in sapphire and diamond jewels. The results are recorded in Ref. T/T51, "Further Researches on the Phenomenon of Debris formed in a Meter-Type Bearing with Special Refrence to Osmium-Rhodium/Sapphire and Diamond Combinations," by G. F. Shotter (price 7s 6d). Tests with various speeds and weights have given some interesting results as regards the debris formed. These exploratory experiments are of value as giving a lead to further experiments on other materials.

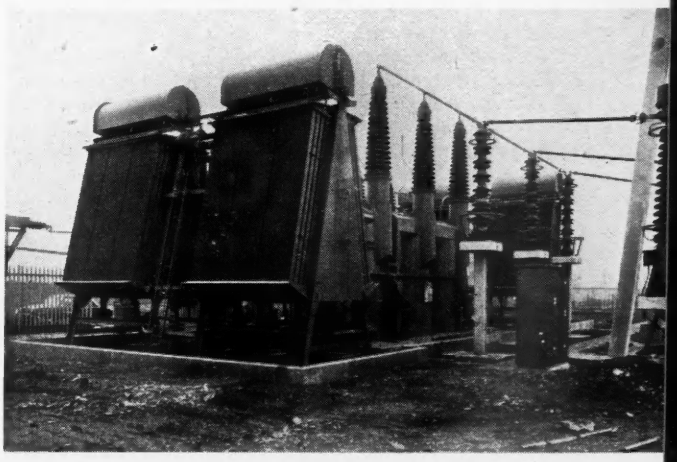
MANUFACTURING PROGRESS IN 1956

Activities of C. A. Parsons & Co., Ltd.

AMONG the many orders for turbo-alternator plant received by C. A. Parsons & Co., Ltd., during 1956, were those for a 200 MW machine for a new power station in England and three for Canada. The machine for England has been ordered by the Central Electricity Authority and is a single line unit running at 3,000 r.p.m. and driving a single hydrogen and liquid cooled generator. The turbine is of the four-cylinder type with an h.p., i.p. and two double flow l.p. cylinders. The steam conditions are 2,350 lb/sq in, 1,050 deg F, with reheating between the h.p. and i.p. cylinders to 1,000 deg F.

The orders for Canada are for three 200 MW turbo-generators and these will be the first 200 MW machines to be exported from England and the first to be installed in Canada. They have been ordered by the Hydro-Electric Power Commission of Ontario for the Richard L. Hearn generating station, Toronto. These new machines are of the cross compound design, the h.p. line running at 3,600 r.p.m. and the l.p. line at 1,800 r.p.m., each line being coupled to a 100 MW alternator. The steam conditions are 1,800 lb/sq in and 1,000 deg F, with reheating to 1,000 deg F.

Four 66 MW turbo-generators running at 3,600 r.p.m. have also been ordered for power stations in Canada. Two of these machines will be installed in the Boundary Dam generating station, Saskatchewan, while the other two are for a new power station near Winnipeg. The four machines are of similar design comprising two-cylinder turbines driving hydrogen-cooled generators. The steam conditions are 850 lb/sq in and 900 deg F. Turbo-generators of 15, 20 and 30 MW capacities have been ordered for power stations in Jamaica, India, Canada and Nigeria.



This 120 MVA equipment is believed to be the largest three-winding transmission transformer yet constructed for the 275 kV grid

A large number of turbo-alternators with a total output of over one million kW have been commissioned during the year, approximately half of which were installed in power stations overseas, while the remainder were installed in the United Kingdom.

Nuclear Power Plant

During the year the power plant installed at Calder Hall "A" nuclear power station, comprising four 23 MW turbo-generators, eight gas circulators and two auxiliary gas circulators, was put into commission. The Calder Hall station was officially opened by Her Majesty the Queen on 17th October (see *Electrical Review*, 19th October).

An order was received from the C.E.A. for a 210 MVA, three-phase generator transformer for direct connection to the 275 kV supergrid system, and a similar transformer, having a rating of 106 MVA at 275 kV, was ordered for installation at the Authority's Ferrybridge "B" power station.

As a result of the increase in size of generating plant for the C.E.A., an order for two 72 MVA transformers has been replaced by one for two transformers each having an output of 144 MVA, for operation at 132 kV at Skelton Grange "B" power station. Further, two additional 120 MVA, three-phase, auto-transformers for interconnection between the 275 kV and 132 kV grid systems have been ordered during the past twelve months. Work is also in progress on two more 72 MVA generator transformers, and three 45 MVA and six 30 MVA transmission transformers suitable for operation at 132 kV.

Eleven shunt compensating reactors have been ordered for the Kariba hydro-electric scheme in Rhodesia. Two of these will have a rating of 40 MVA for installation at the Kariba power station and will be water cooled, while the remaining nine will have a rating of 20 MVA and will be naturally cooled.

Orders for transformers and current limiting reactors for use in many different parts of the world have been received, including two 45 MVA 132/88/66 kV star-auto

A 5 MVA 132/33 kV transformer mounted on a trailer, forming part of a mobile substation for Damodar Valley Corporation, India

connected ON/OFB cooled units, fitted with off-circuit tappings, for South Africa.

A number of furnace transformers having secondary currents of between 13,000 and 53,000 A have been completed during the year and orders for a number of similar units are in hand.

The largest three-winding, 275 kV 120 MVA transmission transformer yet constructed for the 275 kV grid has been installed at Blyth and a similar unit is in course of erection at the same site. Three 120 MVA 275/132 kV auto-transformers were commissioned at Stella West substation. Another interesting order completed during the year was for a 5 MVA 132/33 kV transformer mounted on a trailer, to form part of a complete mobile substation for the Damodar Valley Corporation, India. The unit is provided with off-circuit tappings of plus and minus 2½ per cent and 5 per cent. The unit is of the forced oil air blast cooled type with 100 per cent standby cooling capacity provided. The supplies for the auxiliary motors and substation equipment are obtained from a 35 kVA 33 kV/400 V transformer housed in the same tank as the main unit.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

The International Ohm

IN answer to the query from Mr. E. J. Beaven in the *Electrical Review* of 2nd November, the use of mercury for a resistance standard was first advocated by Marié Davy and De la Rue in 1850 because of the high degree of purity that could be obtained with it. The first mercury standard resistance was constructed by Werner Siemens in 1860.

Before 1881 Germany and some other countries were using mercury for a standard ohm, but Britain employed a platinum silver alloy for the purpose. It subsequently transpired that for more than ten years confusion had been caused by an error in the British standard.

At the International Electrical Exhibition in Paris in 1881 the subject was thrashed out between the nations, resulting in a unanimous declaration by the 46 delegates that henceforth the international ohm was to be of mercury.

The case put by Germany was that the Siemens mercury unit possessed the great merits of simplicity of definition and facility for being reproduced if destroyed, anywhere in the world, and that mercury could easily be refined to a high degree of purity.

The latest definition of the international ohm is contained in the lengthy "Specification relating to mercury standards of resistance" determined by the International Conference on Electrical Units and Standards held in London in 1908 and opened by the then President of the Board of Trade, the Right Hon. Winston S. Churchill, M.P. It was at this conference that the term "international ohm" was universally agreed upon.

The "unvarying current"—as distinct from a pulsating, alternating, or polarising current—used for measuring the ohm—would be that normally associated with the particular measuring equipment employed.

There is not much doubt that the term "unvarying" was originally inspired by the phenomenon of polarisation in primary batteries which were much more in evidence 70 years ago.

Norbury, S.W.16. B. S. T. WALLACE.

Water-Cooled Alternator Windings

THE introductory remarks to the description of an arrangement for water cooling the stator windings of turbo-alternators published in the *Electrical Review* of 19th December present the effect on design of this innovation in a somewhat incorrect perspective. They also hardly do justice to the other recent development, viz. direct gas cooling of the rotor windings which, by increasing the permissible excitation power, has lifted the value of a fundamental limit in design to such a point that units with an output in excess of 200 MW are practicable.

With effective ventilation methods available for both rotors and stators, the original problem of temperature rise has become of less importance and in a balanced design emphasis must now be placed firstly on the economic level of total loss in the alternator and, secondly, on its distribution to ensure the absence of local concentrations. For example, consider the suggestion that with some modification to the shaft and bearings of the present 30 MW frame an output of 150 MW could be obtained. For the same electrical characteristics, i.e. power factor and short-circuit ratio, in the most favourable circumstances the variable losses must be increased by a factor of the order of 25, and assuming constant fixed loss this would reduce the efficiency by about 2½ per cent. This reduction is economically unacceptable. Furthermore, the increased stator current loading, which is permissible as far as the windings are concerned, will pose a serious problem in the magnitude of the loss at the ends of the stator.

Some method of directly cooling the stator windings is undoubtedly advantageous in reducing the overall size and so increasing the unit output within the somewhat artificial limit of transport weight imposed by our antiquated road system, but it is not a means of achieving a five-fold increase in output from a present-day machine.

Witton, Birmingham, 6. V. EASTON,
Engineering Design Development,
General Electric Co., Ltd.

Beyond the Motor Coupling

IN his article "Beyond the Motor Coupling" in the *Electrical Review* of 21st December Mr. A. W. Leadbeater suggests that the "high torque" squirrel-cage motor offers some advantage over the "straight cage" motor for a high inertia fan drive. (Pumps—also cited—are never of high inertia.) Even supposing that by the undefined term "high torque" Mr. Leadbeater really means "low starting current"—and in spite of a widespread belief to the contrary the two terms are, of course, a long way from being synonymous—his contention can be correct only in respect of stator winding heating, which is seldom in practice the most significant factor.

It can be readily shown that the amount of energy liberated as heat in the rotor of a line started squirrel-cage induction motor during acceleration is almost independent (for normal machines and within ordinary practical limits) of the torque/speed curve of the motor. Consider, for example, a 100 h.p., 4-pole, 50 c/s motor with a full load

speed of 1,450 r.p.m., driving a fan of inertia 1,600 lb ft², and suppose that alternative rotors are available, one being of "normal torque" design with static and maximum torques of full load and twice full load, respectively, and the other being of the "high torque" type having approximately equal static and "maximum" torques of about twice full load. The exact values, and the precise shapes of the two torque/speed curves, are of no practical significance. If the appropriate calculations are made, it will be found that although the high torque rotor will accelerate the fan to full speed in only 13 seconds against the 22 seconds taken with the normal torque rotor, the amounts of energy liberated as heat in the two rotors are very nearly equal. In the absence of any load torque these two energy quantities would of course be exactly equal, not only to each other but also to the amount of stored energy in motor and transmission gear at full speed. The temperatures of the two rotors at the end of the accelerating period may therefore be expected to be approximately equal; in fact, if the high torque rotor is constructed with two or more separate cages it is probable that the temperature of the outer cage would exceed that of any part of the single-cage rotor, since the outer cage would normally engender a greater proportion of the total liberated energy than its share of the total heat capacity would warrant.

It will be found that rotor heating is in practice almost invariably the most important factor in these high inertia acceleration problems; the acceptance of the extended starting time necessary with the normal torque motor may be inconvenient in respect of motor protection or distribution system disturbance, but it is seldom of any real significance so far as the motor itself is concerned. For example, the stator winding temperature rise of the typical normal torque motor already referred to would be considerably lower after a start than the normal full load temperature rise.

In general, therefore, it can be stated that for a high inertia drive such as a fan the high torque rotor offers no significant advantages; the really important point is that whatever motor torque/speed curve is selected (and the smoothly accelerating characteristic of the usual normal torque motor can surely be hardly bettered for a fan drive) the thermal capacity and the construction of the rotor must be suitable in every way for the absorption of the energy which will be liberated as heat during the starting period. On high inertia drives with a reasonable accelerating torque margin it will be found in practice that this liberated energy will be about 1¼ to 1½ times the stored energy in the motor and transmission system, and it is therefore very important that accurate information about the drive inertia should be made available to the motor designer.

Edinburgh, 12. J. GRIFFIN, A.M.I.E.E.

Private Generating Plant

IN his letter published in your issue of 21st December, Mr. Maitland Makgill Crichton very pertinently asks why a chasm should exist between the administrators of public electricity supply and those owners of private plant who are willing to contribute their quota.

During my recent negotiations with the public supply authorities regarding connection to the grid of a small private hydro plant, I think I discovered the answer. It lies in the price offered by the public authority to the private owner for current returned to the grid. In the case known to myself, the price offered is 0·3d/kWh for electricity which the North of Scotland Board sells at an average of more than 1·5d. This represents a profit of 400 per cent without any expenditure or processing having to be undertaken. Most businesses in private hands would be content with a rate of profit less than one-tenth of this.

It would be interesting to know by what arguments such extortion is justified. Cost of distribution and connection cannot be the reason, because the client is already called upon to pay a large sum for connection, and it remains the same whether current is flowing to or from the site. The Hydro Board's representative argued that the consumer's peak demand would coincide with the Board's peak and that any current returned to the grid would be at times when it was least required. This argument was, I think, invalidated by the fact that the Hydro Board was more than anxious to take the consumer's *whole* load (without the assistance of the consumer's own hydro plant) and surely this would have made the Hydro Board peak higher than ever. As for the current being returned at a time when it was unwelcome (e.g. during the night) it was again pointed out that this allowed the Board's depleted dams to recuperate more quickly by precisely the amount of the consumer's contribution.

Not all private plant owners receive such a miserable remuneration. I believe there are some with excellent up-to-date hydro plants capable of carrying a good base load at all times, who receive as much as 0·5d/kWh. Nevertheless, I am sure Mr. Crichton will agree that even that sum is inadequate and that all should receive approximately the same as that which it costs the Board to generate, i.e. 0·88d. At this price private generation would be encouraged and the national economy assisted.

Rosehall, near Keith, Banffshire. S. G. LAIDLAW.

Underwater Ballistics

THE design and construction of a laboratory for Admiralty research in underwater ballistics was described by Messrs. C. L. Champion, R. J. R. Hancock and M. Woolfson (Ministry of Works) in a paper presented recently before the Institution of Civil Engineers.

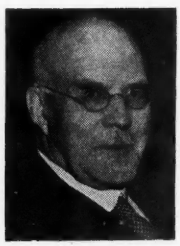
The main features of the installation consist of a rotating arm for propelling models round an annular tank and a cavitation tunnel. The arm is gear-driven by a 1,510 h.p. electric motor capable of accelerating the model from standstill to 37·5 ft/sec in one revolution and to a maximum speed of 150 ft/sec. The speed is controlled either by hand or by an automatic electronic controller capable of holding the speed constant within 0·1 per cent. For the cavitation tunnel the relation of flow to head indicated the use of an axial-flow pump of 660 water h.p.

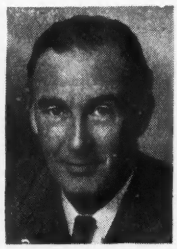
Electricity is supplied to the establishment at 11 kV which is used directly for the main units and transformed to 440-230 V for auxiliary power and lighting. Both the rotating arm and the pump are driven by d.c. motors on the Ward-Leonard system, incorporating main 11 kV synchronous motors direct-coupled to variable voltage d.c. generators and a number of exciters. Starting current is limited by a reactor, which is switched out when speed approaches synchronism. Accuracy of speed control has been achieved by using a closed-loop servo acting on the field of the main generator exciter. The speed of the motors is measured by an electric tachometer and compared with a stable reference voltage, any error being applied to an electronic system which adjusts the generator exciter field.

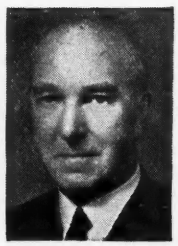
The contractor for civil engineering work was Richard Costain, Ltd., and the main contractor for mechanical and electrical plant was Costain-John Brown, Ltd. The electrical sub-contractor was the English Electric Co., Ltd.

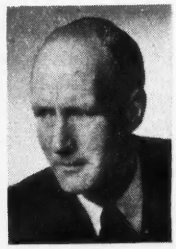
Sir John Cockcroft

Sir Stanley Angwin


Sir Harold Hartley


Mr. J. N. Dean


Mr. J. Eccles


Sir Christopher Hinton

New Year Honours

THERE are a number of well-known men in the electrical and allied industries in the New Year Honours List published last Tuesday, and from the list we have selected those given below.

Sir John Cockcroft, K.C.B., C.B.E., director of the Atomic Energy Research Establishment at Harwell, receives the Order of Merit. **Col. Sir Stanley Angwin,** K.B.E., D.S.O., M.C., T.D., chairman, Commonwealth Telecommunications Board, becomes a Knight Commander of the Order of St. Michael and St. George (K.C.M.G.) and **Mr. R. J. Halsey,** B.Sc.(Eng.), M.I.E.E., Assistant Engineer-in-Chief, G.P.O., is appointed a Companion of the Order (C.M.G.). **Brig.-Gen. Sir Harold Hartley,** K.C.V.O., C.B.E., M.C., president of the World Power Conference since 1950, is appointed a Knight Grand Cross of the Royal Victorian Order (G.C.V.O.).

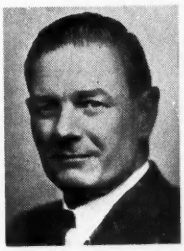
Knighthoods have been conferred upon **Mr. D. S. Anderson,** Director, Royal College of Science and Technology, Glasgow, **Mr. J. N. Dean,** B.Sc., F.I.R.I., A.I.C., chairman, Telegraph Construction & Maintenance Co., Ltd., **Mr. J. Eccles,** C.B.E., M.M., M.I.C.E., M.I.E.E., deputy chairman (operations), Central Electricity Authority, and **Mr. W. L. Owen,** C.B.E., director of engineering, United Kingdom Atomic Energy Authority's Industrial Group.

Sir Christopher Hinton, F.R.S., M.A., M.I.C.E., M.I.Mech.E., member of the Board, U.K.A.E.A., becomes a Knight Commander of the Order of the British Empire (K.B.E.).

New Commanders of the Order (C.B.E.) include **Mr. A. A. Fulton,** B.Sc., M.I.C.E., M.I.Mech.E., F.R.S.E., general manager, North of Scotland Hydro-Electric Board, and **Mr. O. W. Humphreys,** B.Sc., M.I.E.E., A.M.Amer.I.E.E., director, Research Laboratories, General Electric Co., Ltd. In the list of Officers of the Order (O.B.E.) are **Captain J. P. F. Betson,** commander, H.M.T.S. *Monarch,* G.P.O.; **Lt.-Col. F. A. Hough,** M.B.E., A.M.I.E.E., chief regional engineer, London Postal Region, G.P.O.; **Mr. E. G. James,** B.Sc., Ph.D., A.M.I.E.E., leader of the valve group, Research Laboratories, General Electric Co., Ltd., Wembley; **Mr. P. McKearney,** M.I.E.E., assistant chief mechanical and electrical engineer, Ministry of Works; **Mr. J. Nadin,** general manager and director, D.P. Battery Co., Ltd., Bakewell; **Mr. A. H. Roche,** A.M.I.E.E., telecommunication engineer in charge of submarine cable system development and production division, Standard Telephones & Cables, Ltd.; **Mr. A. E. Roots,** M.I.E.E., area manager, South of Scotland Electricity Board; **Captain T. A. Vickers,** R.D., commander, Cable Ship *Mirror,* Cable & Wireless, Ltd.; and **Mr. H. K. Worship,** general manager, Thorpe Road Works, Laurence, Scott & Electromotors, Ltd., Norwich.

Among the new Members of the Order (M.B.E.) are **Mr. J. H. Bowden,** service manager, Mirrlees, Bickerton & Day, Ltd., Stockport; **Mr. V. W. N. Bowles,** chief telecommunications superintendent, London Telecommunications Region, G.P.O.; **Miss Beatrice K. Chaplin,** executive officer, Radio Research Station, D.S.I.R.; **Mr. W. C. Cropper,** group leader, Research Laboratories, General Electric Co., Ltd.; **Mr. J. E. Day,** assistant engineer, Research Station, G.P.O.; **Mr. C. H. Evans,** personnel manager, Automatic Telephone & Electric Co., Ltd., Liverpool; **Mr. T. J. Fluendy,** lately sub-area commercial officer, Southern Electricity Board; **Mr. J. H. Gray,** senior mechanical designer-draughtsman, W. H. Allen, Sons & Co., Ltd., Bedford; **Mr. W. H. Hopkins,** works manager, E.M.I. Factories, Ltd., Wembley; **Mr. J. F. Howey,** works manager, Clarke, Chapman & Co., Ltd., Gateshead; **Mr. J. Lindsay,** chief generator erector, Bruce Peebles & Co., Ltd., Edinburgh; **Mr. W. W. Syrett,** export manager, E. K. Cole (Radio Division), Ltd., London; **Mr. W. Warren,** M.I.Mech.E., M.I.E.E., M.I.F., generation engineer (operation), East Midlands Division, Central Electricity Authority; and **Mr. D. B. Webbe,** mechanical and electrical engineer, Air Ministry.

Recipients of the British Empire Medal include **Mr. W. D. Bruce,** h.v. jointer, South of Scotland Electricity Board (Glasgow); **Mr. J. Buck,** mains foreman, North Western Electricity Board (Manchester); **Mr. J. A. Cook,**


Mr. O. W. Humphreys

Mr. H. K. Worship

maintenance engineer, Submarine Cables, Ltd., Erith; **Mr. J. L. Doughty,** turbine driver, Birchills power station, Midlands Division, C.E.A. (Walsall); **Mr. J. E. Downing,** chargehand inspector, Ferranti, Ltd., Manchester (Oldham); **Mr. F. J. Franklin,** chargehand labourer, Coventry power station, East Midlands Division, C.E.A. (Coventry); **Mr. M. Gemmell,** boring mill operator, G. & J. Weir, Ltd., Glasgow; **Mr. H. F. Hewitt,** skilled machinist, Veritys, Ltd., Birmingham; **Mr. G. E. Jennings,** substation attendant, Merseyside and North Wales Electricity Board (Liverpool); **Mr. E. F. Neve,** foreman, submerged repeater manufacturing shop, Standard Telephones & Cables, Ltd., London; **Mr. R. A. W. Pantenay,** technician I, Engineer-in-Chief's Office, G.P.O. (Eastbourne); **Mr. J. W. E. Pearson,** electrician, Highland District, War Office (Stirling); **Mr. G. Powell,** vehicle mechanic, North Eastern Electricity Board (Wallsend), **Mr. A. W. Rowley,** foreman, General Electric Co., Ltd., Wembley (Greenford); **Mr. C. Willis,** chargehand welder, Ferrybridge "A" power station, Yorkshire Division, C.E.A. (Leeds); and **Mr. L. Deschamps,** superintendent of telephones and electrical inspector, Telephone Department, Windward Islands.

Power Plant in 1956

During the year ended 31st December, 1956, new generating plant installed by the Central Electricity Authority had an output capacity of 1,797 MW and plant installed by the South of Scotland Electricity Board of 140 MW—a total of 1,937 MW for the area of the former British Electricity Authority. This constitutes a new record, being 12½ per cent more than in 1955. Details of the plant will be given in our next issue.

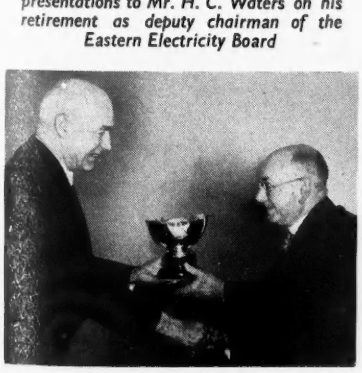
PERSONAL AND SOCIAL

News of Men and Women of the Industry

THE directors of Electric & Musical Industries, Ltd., announce that **Mr. J. N. Macleod** and **Mr. C. Metcalfe** have been appointed directors of the company, and that they, together with **Mr. E. J. Emery,** who was appointed a director last February, have been appointed managing directors of the company. They will be responsible, respectively, for the U.K. Record Division and the overseas subsidiary companies (other than Capitol Records, Inc., and its subsidiaries), the E.M.I. Electronics Division (commercial and industrial equipment), and the Domestic Electronics Division, of the company.

Mr. H. A. Lewis, M.B.E., T.D., B.Sc.(Eng.), A.C.G.I., M.I.E.E., personal assistant to Mr. E. J. Emery, managing director of the Domestic Electronics Division of Electric & Musical Industries, Ltd., has been appointed a director of E.M.I. Sales & Service, Ltd.

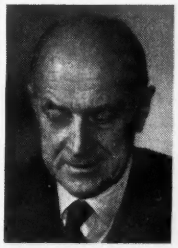
Mr. H. C. Waters, M.I.E.E., deputy chairman of the Eastern Electricity Board since nationalisation, retired at the end of 1956. Mr. Waters served his apprenticeship with Crompton & Co. (now Crompton Parkinson, Ltd.) at Chelmsford, with whom he later served in the drawing office and blueprint department. As a senior draughtsman during the 1914-18 war he designed special machines to aid the war effort, gaining experience in the design of dynamos and motors. For a period Mr. Waters worked for a small firm at Croydon where train dynamos were made, but returned to Crompton's with whom he remained until 1918. At the end of the 1914-18 war he joined the East Anglian Engineering Co., dynamo and motor manufacturers, as draughtsman and designer and designed a complete range of new machines for them, taking out a number of patents. Mr. Waters was successively promoted from draughtsman and designer to the post of technical director and then to that of managing director, while the company, which is now known as Bull Motors, became associated with a number of other concerns. In 1925 Mr. Waters joined the former East Anglian Electric Supply Co., Ltd., at Felixstowe, and when the industry was nationalised in 1948 he was the general manager not only of that company but also of the Bedfordshire, Cambridgeshire & Huntingdonshire Electric Supply Co., and of the Newmarket Electric Light Co. Mr. Waters is a Fellow of the Royal Society of Arts and a magistrate on the Stowmarket bench. He is also a member of the British Institute of Agricultural Engineers and an associate member of the British Horological Institute.



Mr. C. T. Melling (left) making the presentations to Mr. H. C. Waters on his retirement as deputy chairman of the Eastern Electricity Board

At the staff Christmas dinner of the Eastern Electricity Board Mr. C. T. Melling, chairman of the Board, presented Mr. Waters with a rose bowl and a lawn mower on behalf of the staff.

Mr. R. D. Bangay, foreign manager of Marconi's Wireless Telegraph Co., Ltd., retired at the end of December after serving with the company more than fifty-four years.



Mr. R. D. Bangay

Mr. Bangay qualified as an engineer at the City and Guilds Technical College, Finsbury, under Professor Silvanus P. Thompson, and entered the newly founded Marconi College, which at that time was in Frinton, Essex. Later in the same year he went to America where he remained on company business for the succeeding five years, during which time he helped to install many radio stations, including the first U.S. coastal station at Babylon. On his return to England in 1907 he took up the study and development of radio for military purposes and subsequently the original experiments in air-to-ground communication. In 1914 he was placed in charge of the Field Station Department, established by Marconi's for the development of military radio.

In 1921 he was appointed chief of designs and subsequently became technical representative abroad in 1925; his appointment as foreign manager followed in 1935. Mr. Bangay is the author of two early text books on radio, "The Elementary Principles of Wireless Telegraphy" and "The Oscillation Valve." Although he relinquishes the position of foreign manager he will continue to serve the company on special projects and duties in connection with overseas business.

The board of **Steels Engineering Products, Ltd.,** is now constituted as follows:—Messrs. J. Steel (chairman), A. Hallsworth (managing director), A. G. Howe (finance), R. J. Lester (design), R. L. E. Keates (home sales), R. F. Albon (overseas sales) and D. Hassall (production). Mr. Keates will be resident at the home sales office at 143, Sloane Street, London, S.W.1, and Mr. Albon at the overseas sales office at 14, Berkeley Street, London, W.1. The other directors and the departments responsible to them will be at Crown Works, Sunderland.

Mr. Eric Crewdson, M.C., T.D., B.Sc., A.M.I.C.E., has retired from the board of Gilbert Gilkes & Gordon, Ltd., just over fifty years after he started work with the company as a premium apprentice. This will allow him greater freedom to direct the research and technical development work of the company. He will continue to represent it on the Committee of the British Hydromechanics Research Association and other engineering and research organisations. Mr. Crewdson was chairman of the company for twenty years and has been a director for thirty-seven years.

Mr. G. C. Handley has relinquished his appointment of London manager of Contactor Switchgear, Ltd., in order to return to the North of England. **Mr. G. E. Jones** has been appointed in his place with effect from 1st January.

Mr. Frank Rowe, B.Sc., F.I.I.A., has been appointed a director of the George Cohen 600 Group, Ltd., the holding company which controls the 600 Group. The appointment is effective from 1st January. Since 1943 Mr. Rowe has been managing director of K. & L. Steelfounders & Engineers, Ltd., one of the largest companies in the 600 Group, and he will continue to hold this position. Mr. Rowe was educated at Manchester Grammar School and, before going to Manchester University to read metallurgy, served a three years' apprenticeship with the Metropolitan-Vickers Electrical Co., Ltd.

Mr. F. Rowe

Mr. Rowe is a member of the

Council of the British Institute of Management, a Liveryman of the Worshipful Company of Founders, and a Freeman of the City of London.

The Minister of Fuel and Power has appointed **Mr. G. A. Howe,** M.A., LL.B., A.C.A., to be a part-time member of the North Western Electricity Board. Mr. Howe is shortly retiring from the position of chief accountant of the Manchester Ship Canal Co. The following members of the North Western Board have been reappointed for a further term: **Messrs. M. L. Hazelden, B. Pickup** and **H. E. Rhodes.**

Sir Cecil Oakes, C.B.E., D.L., J.P., of Woodbridge, Suffolk, has been reappointed as a part-time member of the Eastern Electricity Board.

At a meeting of the Bedford Branch of the Electrical Power Engineers' Association held on 1st December tributes were paid to **Mr. A. A. Nimmo,** who recently retired from the position

Mr. A. A. Nimmo (left) receiving a presentation from Mr. J. E. Stanton (president of the E.P.E.A.) on his retirement from the Eastern Electricity Board

of district engineer of the Eastern Electricity Board, Bedford. Mr. J. E. Stanton, the president of the Association, made a special visit to Bedford for the occasion in order to present Mr. Nimmo with a testimonial in the form of an embossed leather-bound book containing the signatures of his colleagues. In presenting the testimonial, together with a cheque, Mr. Stanton wished Mr. Nimmo a happy retirement.

Mr. H. L. A. Foy has been appointed publicity manager of Decca Radar, Ltd., in succession to **Mr. S. J. Mattock,** who has recently left the company.

Brook Motors, Ltd., announces the retirement of **Mr. J. P. Swain,** manager of its Leicester sales office. Mr. Swain, who has been associated with the company for thirty years, is succeeded by **Mr. K. Broom,** A.M.I.E.E., who joined the company in 1937 and received his electrical

Mr. J. P. Swain

Mr. K. Broom

engineering training at the Huddersfield works before being appointed technical adviser and sales engineer at Leicester in 1943, a position he has held up to the present time.

Sir Summers Hunter retired on 31st December from the board of Richardsons, Westgarth & Co., Ltd., the parent company of the Richardsons, Westgarth group. He has been elected hon. president of the North Eastern Marine Engineering Co., Ltd., which is the company in the group with which he has been associated for fifty years. **Mr. Harry Hunter** also retired from the parent board on 31st December, but continues to be a member of the boards of the North Eastern Marine Engineering Co., Ltd., and George Clark & North Eastern Marine (Sunderland), Ltd. **Mr. J. E. Smith,** managing director of North Eastern Marine, and **Mr. G. L. Hunter,** marine sales director of the group, have been appointed to the parent board as from 1st January.

Mr. A. H. I. Kinsman, a member of the parent board, has been appointed to the board of George Clark & North Eastern Marine (Sunderland), Ltd. **Mr. P. Kendra,** who has held the position of works manager at the Southwick Works at Sunderland since 1946, has also been appointed a director of George Clark & North Eastern Marine (Sunderland), Ltd.

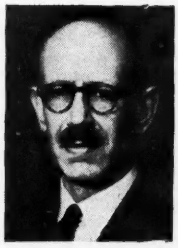
Mr. A. D. McN. Boyd has been appointed land sales director of Richardsons, Westgarth (Hartlepool), Ltd., and **Mr. E. A. Eborall** and **Mr. J. E. Lee,** who have been respectively London land manager and Northern manager at Manchester for a number of years, have been appointed regional directors of that company.

Mr. C. M. L. Walker has been appointed sales consultant in the Midlands for Ferranti, Ltd. He is well known in electrical circles in the Birmingham area and has been a member of the Committee of the Birmingham Electric Club. He went to the Midlands on meter sales in March, 1927, and was appointed area manager in July, 1945. **Mr. R. S. Winter** has been appointed area manager in succession to Mr. Walker.

The following appointments in the Vickers group of companies are announced:—**Mr. E. E. Kennaird** (sales manager) has joined the board of Cooke, Troughton & Simms, Ltd., surveying, optical and scientific instrument makers, and **Mr. H. F. Judd,** Associate I.E.E. (general sales manager), of Ioco, Ltd. (manufacturers of plastics and rubber products), has joined the board of that company.

The **Electrical Trades' Commercial Travellers' Association** held its annual dinner and smoker on 14th December at the "Windsor Castle," Victoria, London, and a record gathering of nearly 200 members and guests attended. The guest speaker was Mr. Tom Fallon, ex-superintendent of police at Scotland Yard, and after his amusing talk there was a musical entertainment.

At its last meeting, following the death of Mr. P. V. Hunter, C.B.E., Hon.M.I.E.E., past president, the Council of the Institution of Electrical Engineers appointed **Mr. Forbes Jackson,** M.I.E.E., who has served on the Wiring Regulations Committee since 1945, and as its vice-chairman



Mr. Forbes Jackson

Mr. S. E. Goodall

since 1954, to succeed him as chairman of the Committee. At the same time it appointed **Mr. S. E. Goodall,** M.Sc.(Eng.), M.I.E.E., who has been a member of the Committee on the nomination of the Cable Makers' Association since 1952, and is a vice-president of the Institution, to serve in a personal capacity and to fill the office of vice-chairman. The Council paid a tribute to the long and valued services given by the late Mr. P. V. Hunter to the electrical engineering profession in this and other capacities.

Two new sales appointments are announced by the Chloride Group of Companies. **Mr. T. Dawson** has taken up the new post of group export sales manager and will, in addition, be

Mr. T. Dawson (left) and Mr. P. C. Aspinall

responsible for commercial liaison with the group's overseas associate companies. **Mr. P. C. Aspinall,** who was assistant export manager under Mr. Dawson, becomes the new export manager for Chloride Batteries, Ltd., in succession to Mr. Dawson.

Mr. S. Erickson, chief draughtsman of A. T. & E. (Bridgnorth), Ltd., has resigned his position with the company to take up a senior appointment with the Stromberg-Carlson Co., Ltd., Rochester, New York. Before joining A. T. & E. (Bridgnorth) Mr. Erickson was with Government communications headquarters (Foreign Office), Cheltenham, Burndept (Vidor), Ltd., Morphy-Richards, Ltd., and for many years at the G.E.C. Radio & Telephone Works, Coventry.

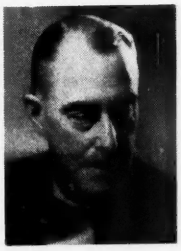
Professor C. Holt Smith, C.B.E., M.Sc., M.I.E.E., the head of the Department of Instrument Technology at the Royal Military College of Science, Shrivenham, has been seconded for three years from 31st December last to be Dean of the Institute of Armament Studies, Kirkee, Poona, India. Professor Smith's studies lie in the field of discontinuous and non-linear servomechanisms. **Professor K. Hayes** is taking over Professor Smith's duties at Shrivenham.

Mr. L. S. Turner and **Mr. R. E. B. Harris** have been appointed directors of the Sloan Electrical Co., Ltd.

Mr. Turner joined the company in January, 1932, and has been secretary for the past twenty-five years.

Mr. Harris is the company's Bristol manager. He joined the company in

Mr. L. S. Turner



Mr. R. E. B. Harris

September, 1933, as manager of the Kingsway, London, showroom and was subsequently transport manager at Fetter Lane, E.C.4. He was appointed branch manager at Bristol in 1938.

The **Institution of Electrical Engineers** announces that tickets are still available for the dinner-dance of the Utilisation Section at the Café Royal, Regent Street, W.1, on 16th January. Applications should be made to the secretary of the Institution, Savoy Place, London, W.C.2.

Mr. G. L. Lawford, secretary of the Telegraph Construction & Maintenance Co., Ltd., and its subsidiary and associated companies, retired at the end of December after forty-two years' service with the company. Mr.

Mr. G. L. Lawford being presented with a gold wrist watch and a silver salver by Major H. Denison-Pender, a director of Telcon

Lawford was with Deloitte, Plender, Griffiths & Co., auditors, before joining Telcon, and was seconded by Deloitte's to the company at the outbreak of the 1914-18 war. He was taken on the permanent staff in 1915, and subsequently became registrar and acting secretary before succeeding the late Mr. Musgrave as secretary in 1947.

Mr. W. A. Knipe, technical manager of Sciaky Electric Welding Machines, Ltd., has been elected to the board of directors. He joined the company in 1936, becoming chief designer in 1940 and technical manager in 1948. Previously he had spent seven years with Broom & Wade, Ltd. As an authority on resistance welding, he has contributed articles to the technical Press and has written a number of pamphlets. He is a member of a number of committees, including the technical committee of B.E.A.M.A. on resistance welding.

Mr. H. A. Springer, A.M.I.E.E., has been appointed joint managing director, with Mr. C. H. Bacon, of Sangamo Weston, Ltd., as from 1st January. Mr. Springer joined Sangamo Weston in 1932 and has held various positions in the Production and Contracts Departments. In 1952 he was appointed contracts manager and became a director in 1953.

The first combined social event of the **Siemens-Ediswan** staffs was held at the Café Monico, London, on 14th December, when a party of 360 attended. Mr. W. E. Taylor (Radio Division) was in the chair and proposed the toast of the company. Response was made by Dr. J. N. Aldington, managing director of the company and president of the Siemens-Ediswan (Head Office) Social Club, under whose auspices the occasion was arranged. The evening's programme included dancing and a cabaret.

The South Wales Electricity Board announces the appointment of **Mr. R. G. Williams,** LL.B., D.P.A., as secretary and solicitor to the Board in succession to Mr. D. G. Dodds, LL.B., who, as already reported, has taken up the appointment of chief industrial relations officer to the Central Electricity Authority. Mr. Williams has been an officer of the Board since its inception and for the past six years has been senior assistant secretary. Before joining the Board's staff he held a senior appointment in the Town Clerk's Department of Cardiff Corporation. He is a native of that city and was educated at Cardiff High School. At present he is hon. secretary of the South Wales and Monmouthshire Group of the Royal Institute of Public Administration.

Thos. W. Ward, Ltd., announce the appointment of the following local directors from 1st January:—**Mr. E. Springthorpe, Mr. C. N. Bradshaw, Mr. E. Wolstenholme, Mr. G. Page, Mr. R. Hadfield** and **Mr. A. Kissack.** The new directors have all spent their entire business life with the company.

Mr. R. E. Davies, who for many years represented the Universal Boilers & Engineering Co., Ltd., Burnley, in the Midlands and South West, has now joined the staff of R. & A. Main, Ltd. (Electrical Division), as Midlands area manager.

Mr. R. E. Davies

The article on "Controlled Excitation" (page 24) is by three authors from the same family, **Mr. J. C. Macfarlane,** O.B.E., Wh.Sc., M.I.E.E., **Mr. J. W. Macfarlane,** Ph.D., Wh.Sen.Sc., F.R.S.E., M.I.E.E., M.I.Mech.E., J.P., and **Mr. W. I. Macfarlane,** A.R.T.C., Wh.Sc., B.Sc., A.M.I.E.E. In 1911 the Macfarlane Engineering Co., Ltd., was founded by six brothers—five engineers and an accountant. Mr. J. C. Macfarlane is to-day chairman of the company. He received his technical education at the Royal Technical College, Glasgow, and was trained with G. & J. Weir, Ltd., Cathcart, where he became assistant works manager in 1897. In 1905 he became engineer and manager of Crompton & Co., Ltd., Chelmsford. He served for many years as a governor of the Royal Technical College, Glasgow, and with the Scottish Centre of the Institution of Electrical Engineers.

Dr. J. W. Macfarlane is the managing director of the family business. Like his father he was educated at the Royal Technical College, Glasgow, of which he is to-day a governor. He is also chairman of the South of Scotland Sub-Centre of the I.E.E.

Mr. W. I. Macfarlane is the director in charge of design. He was educated at the Glasgow Royal Technical College and London University. He is the author of a paper on "Intermittent Load Rating by Probability Methods."

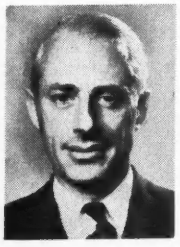
The Council of the Electrical Research Association has appointed **Mr. H. G. Taylor,** D.Sc.(Eng.), D.I.C., M.I.E.E., F.Inst.P., to be director of the Electrical Research Association in succession to the late Dr. S. Whitehead, the appointment to take effect from 1st April next. Dr. Taylor was educated at Taunton School, Plymouth and Devonport Technical College, Barrow-in-Furness Technical College, Battersea Polytechnic and City and Guilds Engineering College, and received his practical training with Vickers, Ltd., and the Metropolitan-Vickers Electrical Co., Ltd. After serving for 8½ years (from 1931 to 1939) as technical assistant with the Electrical Research Association, he was electrical engineer to the Copper Development Association for 5½ years and then manager of the Industrial Development Department of Philips Electrical, Ltd. For the past nine years, up to the present time, he has been director of research of the British Welding Research Association. He is a member of a number of technical institutions and in 1951 was leader of the Welding Productivity Team to the United States.

The Manchester branch of the **Reliance Telephone Co., Ltd.,** held its annual dinner and dance on 15th December at the Mersey Hotel, Manchester. Among those who attended was Mr. E. Silbermann, managing director.

Mr. H. S. Malik, C.I.E., O.B.E., Grand Officier de la Légion d'Honneur, lately Indian Ambassador to France, has been appointed special director (India) of Simon-Carves, Ltd. Mr. Malik will be resident in Delhi where he arrives early this month.

OBITUARY

Mr. G. N. Roberts.—The death occurred on 19th December in a road accident of Mr. Geoffrey N. Roberts, Helsby works manager of British Insulated Callender's Cables, Ltd.



The late Mr. G. N. Roberts

Mr. Roberts, who was fifty-one, joined the Power Cable Department of the former British Insulated Cables, Ltd., at Prescot in 1924. When, in 1945, British Insulated Callender's Cables, Ltd., was formed, he became manager, power cables production division, responsible for power cable production at the Prescot and Erith works of the company. In 1948 he was appointed manager, telecommunications production division, and in 1952 became works manager at Helsby where he was concerned with the complete reorganisation of the Cable and Capacitor Departments there. Only a few weeks before his death, it was announced that he was to become deputy general works manager of the company on 1st January. Mr. Roberts was chairman of the B.I.C.C. Athletic and Social Club (Helsby) and the B.I.C.C. (Helsby) Benevolent Fund. He was also president of Helsby Golf Club.

Mr. Thomas Halliwell Sutcliffe, who had been the marine representative at Newcastle for the General Electric Co., Ltd., since 1927, died on 8th December. Born in 1899, Mr. Sutcliffe was educated at Manchester University where he graduated B.Sc. After serving in the Royal Artillery in the 1914-18 war as a second lieutenant, he joined the G.E.C. in 1921 at the Cardiff branch in charge of Pirelli-General paper sales. In 1927, after his appointment to Newcastle, he took over the Cable Department in addition to his marine responsibilities, and shortly before the last war assumed also the managership of the switchgear and light engineering departments.

Mr. Frank Laycock, a member of the B.T.H. Control Sales Department at Rugby, died on 24th December at the age of fifty-nine. Mr. Laycock joined B.T.H. in 1923 as a test apprentice, and four years later was transferred to the Construction Department. In 1930 he joined what was then known as the Supply Department, but later, when Control Sales was formed, he concentrated on handling tenders for various types of electric control gear for industrial purposes.

Mr. Ernest Pinckston, a director of Laurence, Scott & Electromotors, Ltd., died on 22nd December at the age of sixty-two. Mr. Pinckston joined the company more than twenty-five years ago as manager of the Birmingham branch. He became industrial sales manager in 1939 and was appointed industrial sales director in 1942. In his younger days Mr. Pinckston was keenly interested in association football and became a well-known referee.

Mr. Duncan Samuel Pepper, chairman of Peppers of Woking, Ltd., died on 27th December at the age of seventy-nine.

Mr. Francis D. Gowans, M.I.Prod.E., died on 21st December at the age of forty-seven. He was chief plant engineer for West Coast Paper Mills, Ltd., Fort Bombay, India, and was in this country negotiating for the supply of paper making plant, motors, control gear, etc.

Mr. W. G. Swain, A.M.I.E.E., who died on Christmas Day, was for many years manager of the Sheffield sales office of Lancashire Dynamo & Crypto, Ltd., a position he held until ill-health compelled him to curtail his activities. He was sixty-eight. Mr. Swain received his early training at the Trafford Park Works of L.D.C., which he joined in 1906. Later he was employed on outside service maintenance, combining this with sales representation, being subsequently appointed Sheffield office manager.

Deferment of Scientists and Engineers

Measures to meet "the desperate shortage of scientific and engineering manpower" were announced by Mr. Iain Macleod, Minister of Labour. He said the Federation of British Industries had made representations to him about increasing the number of deferments given to science and engineering graduates so that more could take up employment in industry. On the advice of the Technical Personnel Committee he had decided that university graduates who completed courses of study or training in 1957, and had first-class honours degrees in one of the main branches of science or engineering, would be granted indefinite deferment of National Service if they took employment in this country for which a science or engineering qualification of degree standard was required. He would review the position at the end of 1957.

Mr. Charles Orr-Ewing asked whether deferment could be extended to second-class honours men. Very often the first-class honours man was engaged on research, whereas the second-class honours man did the development work and was particularly valuable in industry, he said.

Mr. Macleod said that the Government had considered the position of second-class honours men but it felt that that would be going too far at this stage, in advance of any general rearrangement of National Service.

Ten-Year Report on Coal

Achievements of the coal industry during the first ten years of nationalisation are reported upon by the National Coal Board in "British Coal: the Rebirth of an Industry," a 52-page brochure published this week. Mr. James Bowman, chairman of the N.C.B., claims that for every six tons produced by the industry ten years ago seven tons are produced now in spite of the growing difficulties associated with the exhaustion of the existing mines and the development of new workings.

It is pointed out that industry is expanding at a greater rate than the output of coal but the report is hopeful in its outlook. The Board's reconstruction and modernisation plan, it is said, will ensure for Britain at the end of another ten years one of the best coal industries in the world and "a firm foundation for the steady and continuous developments which must then follow."

The brochure, which is well illustrated, describes what the Board has done during the last decade and outlines the programme now in progress.

VIEWS on the NEWS

By REFLECTOR

LORD HALSBURY (National Research Development Corporation) was recently criticised in the *Economist* for denying that the "vague" word "automation" had any independent meaning. Unrepentant, Lord Halsbury reiterates his view in the *Economist*, saying that

> "Every one of the topics which are grouped under the heading of automation has in fact a technical name in its own right, and these recognised technical names should be used wherever the context requires it."

In the same issue the editor of a paper called *Automation Progress* endeavours to justify the use of the term as describing something quite independent. He says:—

"Automation has quite a definite meaning to the ordinary engineer. . . . It means converting a process or machine to self-acting (i.e. automatic) operation. This means that automation, as distinct from mechanisation, replaces some mental work, rather than muscle power."

Surely this is a distinction without much difference, for all mechanisation involves the saving of some mental, as well as physical, effort.

* * *

A short time ago I mentioned that the Rev. N. C. R. Aish, the curate son of Mr. Norman Aish, past-president of the Electrical Contractors' Association, who was an electrical installation engineer before he took holy orders, was engaged in wiring his church—St. Mary Magdalene, on the outskirts of Coventry. Now I see from a report in *The Times* that the mounting of some wall brackets has been held up. While chases for wiring were being cut in a wall the plaster broke away, revealing part of a XV century wall painting of St. Christopher, estimated to measure 8ft by 5ft. The vicar has appealed to the local motor car industry to contribute the £150-£200 necessary to uncover and preserve this picture of the patron saint of travellers. But presumably because of the current recession in their business the manufacturers have been slow in responding.

* * *

The most important lesson to be learned from the present petrol shortage is that dependence on imported fuel must be kept to the minimum. This fact, particularly as regards the agricultural industry, is stressed by Mr. C. J. Barnett, chairman of the Blackawton (Devon) Electricity Committee, in a report to the local Council. Calling for a speeding up of rural electrification, he says that in many cases petrol, paraffin or diesel oil provide the light, heat and power in farm buildings. "The nation," he declares, "must awake to the fact that our supplies of home-grown food depend upon imported fuel and the only possible economy is that provided by mains electricity." With electrification, oil fuel need only be used for seasonal work such as ploughing, cultivating and harvesting. Electricity, and the amenities it provides, can also help to prevent further depletion of the number of workers on the land. In Mr. Barnett's opinion, if contractors were employed and use made of the latest devices, rural electrification could be accomplished in less than one-tenth of the time now taken. It is not clear whether this refers only to the physical work of construction, but I imagine that it is in the obtaining of wayleaves, sanctions and the like that most time could be saved.

* * *

To flying swans, cormorants and other large birds, the South Eastern Electricity Board has now added the friendless grey squirrel as among the causes of erratic power supplies in the rural parts of its area. While the rodent may have a price on its tail, however, I gather that the residents of one Sussex village are sceptical about its responsibility for their electricity supply troubles. They complain that it takes three-quarters of an hour to boil a kettle and that at times the power is insufficient to operate the church organ or a radio set, which suggests that low voltage is the main grievance. According to a B.B.C. commentator in last Friday's South East England "Town and Country" programme, in fact, the villagers blame not squirrels but "red herrings." However that may be, birds were clearly the main concern of consumers in a seaside town in the Board's area where a power failure occurred between noon and 1 p.m. on Christmas Day.

* * *

A "kitchen of the future" exhibited at Miami Beach, Florida, has a miniature TV screen linked with a closed circuit so that the housewife can see what is happening in any part of the house. In addition, all the rooms are connected by radio-microphone. Instructions can be dictated into the instrument in the morning and later these can be re-broadcast as reminders of things to be done. A disturbing prospect indeed.

* * *

Eighty years ago, on 1st January, 1877, the *Electrical Review* reported the annual conversazione of the Society of Telegraph Engineers (later the I.E.E.) and mentioned a number of the exhibits arranged on the occasion. Most of the apparatus shown was, of course, of a telegraphic character; it included items from Sir William Thomson (Lord Kelvin), Latimer Clark, W. H. Preece and W. T. Henley. One ingenious device was an automatic telegraph alarm system for the use of police and others; it operated in the following way:—

> "To call for aid a small button, according to the requirements of the case — if for fire that for 'fire,' if for police, that for 'police,' and so on—has to be pressed. The pressure of this plunger or button does not send the signal, but winds up a spring or weight, which brings into position the set signal required to be made. If now the wire is free, that is, if it is not occupied by someone else, a current from the receiving office discharges the spring or weight, and the signal is sent by means of a disc, which under the influence of the spring is revolved, and which in the course of its revolution passes over certain raised studs which interrupt the current, so as to deliver the intended message at the receiving station, where it is recorded on a slip of paper."

INDUSTRIAL NEWS

Cable Makers' Guaranteed Week Agreement

At a meeting of the Joint Industrial Council for the Electrical Cable Making Industry held on 19th December the Council adopted a revised guaranteed week agreement to come into effect on the third pay day of January in respect of the period for which payment is then made. It is the intention of the agreement to guarantee all full-time employees four days or shifts of employment in any pay week of such duration that they can earn 34 hours' pay. Where the customary working day or shift has been in excess of 8½ hours, the excess period is not guaranteed. In such cases the four days will either be of 8½ hours each or of such duration as to give a total of 34 hours. Employees on night work, as defined in Clause 10 of the general agreement, are likewise guaranteed four nights of 8½ hours or of such duration as to give a total of 34 hours. Employees working on a double day shift or three shift system are guaranteed four normal shifts of 8 hours each.

Wireless Telegraphy Interference

The Postmaster - General has appointed an Advisory Committee of nineteen members from a panel nominated by the President of the Institution of Electrical Engineers, with the approval of its Council, to consider the requirements which might be prescribed in regulations dealing with interference with wireless telegraphy caused by industrial, scientific, and medical equipment. The members of the Committee are as follows:—Mr. O. W. Humphreys, B.Sc., M.I.E.E. (chairman), Mr. P. Adorian, M.I.E.E., Dr. P. Bauwens, M.R.C.S., L.R.C.P., Mr. J. I. Bernard, B.Sc.Tech., M.I.E.E., Mr. P. A. T. Bevan, B.Sc., M.I.E.E., Sir Harold Bishop, C.B.E., B.Sc.(Eng.), M.I.Mech.E., M.I.E.E., Mr. N. R. Bligh, B.Sc.(Eng.), A.M.I.E.E., Mr. Paget Bowyer, B.Sc.(Eng.), M.I.E.E., M.I.Prod.E., Mr. A. H. Cooper, B.Sc., Mr. H. Faulkner, C.M.G., B.Sc.(Eng.), M.I.E.E., Mr. J. S. Forrest, M.A., D.Sc., M.I.E.E., Lieut.-Col. M. O'C. Horgan, O.B.E., M.Sc., M.I.E.E., Mr. B. B. Jacobsen, B.Sc.(Eng.), A.M.I.E.E., Mr. C. W. Miller, F.Inst.P., Mr. F. S. Milligan, Mr. E. L. E. Pawley, O.B.E., M.Sc.Tech., M.I.E.E., Mr. C. N. Rocky, Mr. P. Styles and Mr. R. W. J. Sullivan.

Nuclear Energy Management Conference

A conference on nuclear energy for management has been organised by the O.E.E.C. European Productivity Agency, assisted by the Organisation's Nuclear Energy Secretariat, to take place in Paris from 1st to 6th April next. The purpose of this conference is to provide industrialists with information on the present stage of nuclear technical development and the progress made in this field; the economic prospects offered to the European countries and their overseas territories by the development of this new form of energy; the new problems involved in the construction and operation of nuclear plant, especially for the metallurgical, chemical and mechanical engineering industries; and the opportunities offered by the use of radio-isotopes in industry.

The principal papers will deal with the various types of reactors, the first nuclear power plants (Calder Hall in the United Kingdom, Marcoule in France and Shippingport in the United States), the various elements of nuclear energy costs, special materials and equipment required by the nuclear industry, the present position of national programmes and the action being taken at international level. Papers will be read by members of the Atomic Energy Commissions of O.E.E.C. member and associate countries or by industrialists directly concerned with work in this field. The chairman at the first day's meeting will be Professor Francis Perrin, High Commissioner for Atomic Energy (France).

Lightfoot Refrigeration Reorganisation

In view of the expansion that has taken place during the last few years in both the machinery and the cold storage branches of the Lightfoot Refrigeration Co., Ltd., it has been decided, for purposes of simplification of administration and control, to transfer, as from 1st January, the whole of the company's interests in the cold storage industry to a subsidiary company, which has been registered as Lightfoot Cold Stores, Ltd. The first directors are Messrs. B. T. Aikman, B. J. Davis, K. Lightfoot and W. R. Sinclair, all of whom are also directors of the parent company, and Mr. H. Boyd, who has been general manager of the company's cold stores for the past ten years. Mr. J. A. Howie, deputy managing director, has taken over the position of managing director of the parent company from Mr. K. Lightfoot. Mr. Lightfoot, who has been managing director since 1921, will continue as chairman of the Refrigeration company and as chairman and managing director of the Cold Stores company.

Government Copper Stocks

The Board of Trade will shortly offer about 4,800 tons of copper for sale by open tender. This metal formed part of the 36,000 tons offered for sale last October, and consists mainly of cathodes which remained unsold on that occasion. It will be offered for delivery and pricing evenly over the three months February to April next. Tender forms are available from the Board of Trade, C. & G. 7(a), Room 320, Lacon House, Theobalds Road, W.C.1 (telephone: Chancery 4411, extension 338), for return of the completed tenders by 15th January.

Control of Tinplate

The Home Secretary announced in Parliament on 20th November that control of tinplate, terneplate and blackplate would terminate at the end of 1956. The Board of Trade has in consequence made an Order revoking the Iron and Steel Distribution Order, 1951, and Amendments Nos. 1, 2, 3 and 4 to that Order, thus terminating control over the acquisition, disposal, treatment, use and consumption of tinplate, terneplate and blackplate. The Order (the Iron and Steel Distribution (Revocation) Order, 1956 (S.I. 1956 No. 2028)) came into effect on 31st December and is on sale at H.M. Stationery Office, price 2d (by post 4d).

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £267 5s 0d
Fire Refined 99·70%	ton £266 0s 0d
Fire Refined 99·50%	ton £265 0s 0d
COPPER Tubes ..	lb 2s 6½d
Sheet	ton —
H.C. wire and strip ..	ton £309 0s 0d
LEAD, English ..	ton £116 15s 0d
Foreign	ton £115 0s 0d
MERCURY	flask £84 0s 0d
TIN, block (English) ..	ton £777 10s 0d
ZINC, G.O.B. Foreign	ton £102 0s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 1¾d
Sheet	ton —
Wire	lb 2s 10¾d
PHOSPHOR BRONZE Wire	lb 4s 3¼d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb —

E.D.L.A.C. and E.L.F.A. Merge

Auxiliary gear and lighting fittings for electric discharge lamps having now become so closely allied, the Electric Discharge Lamp Auxiliaries Council and Electric Light Fittings Association consider that the trade and the industry as a whole will be more efficiently served by their combining their activities. From 1st January, therefore, E.D.L.A.C. has ceased to operate as a separate body, and the Electric Light Fittings Association, of 103, Kingsway, London, W.C.2 (Hol-

born 4608) has become the trade association concerned with auxiliary gear and lighting fittings.

Clean Air Act in Operation

By the Clean Air Act, 1956 (Appointed Day) Order, 1956, made by the Minister of Housing and Local Government (Mr. Duncan Sandys) certain provisions of the Clean Air Act, 1956, came into operation on 31st December. These include the provisions enabling local authorities to create smoke control areas, in which the emission of smoke from buildings will be an offence. Local authorities will be able to create these areas by Orders which will be subject to confirmation by the Minister.

Other provisions of the Act which are now in force are those stipulating that all new furnaces, other than small domestic boilers, must be smokeless, so far as is practicable; that the Minister may make Regulations requiring furnaces to be fitted with smoke density meters; that the height of new chimneys, other than those of houses, shops and offices, shall be approved by the local authority; that owners of colliery spoilbanks must employ all practicable means for preventing combustion of refuse, and for preventing or minimising the emission of smoke and fumes from the refuse; and that local authorities may make building bye-laws requiring the provision in new buildings of such arrangements for heating and cooking as are calculated to prevent, so far as practicable, the emission of smoke.

A similar Order has been made by the Secretary of State for Scotland. The remaining provisions of the Clean Air Act, which deal with the prohibition of dark smoke, and the reduction of grit and dust from industry, will be brought into operation at a later date.

Census of Production, 1955

The *Board of Trade Journal* has published some preliminary estimates obtained in the 1955 Census of Production; they are said to be based on returns that cover about two-thirds of all persons engaged in production. The figures are compared with the results obtained in the full 1951 Census and with the provisional statistics for 1954.

It is stated that electricity undertakings continued to be the heaviest investors of capital, accounting for £249 million out of a total of £1,137 million in all census industries. But these undertakings' advance on their 1954 expenditure (17 per cent) was not so great as in some of the principal manufacturing industries, e.g. electrical goods, which increased capital expenditure by 32 per cent.

The accompanying table has been compiled from figures given in the *Board of Trade Journal*.

CENSUS OF PRODUCTION 1955

Industry		Gross output	Net output	Employment		Wages and salaries		Capital expenditure	
				Operatives	Others	Operatives	Others	Plant, machinery and vehicles acquired	New building work
		£ million		Thousands		£ million			
Electrical engineering (general)	1951	370·0	187·5	223·0	75·1	73·9	36·7	8·0	2·9
	1955	542·8	279·3	251·9	88·4	116·3	54·4	14·6	6·7
Electric wires and cables	1951	127·6	36·3	37·1	13·0	12·7	6·2	1·9	0·6
	1955	190·9	50·8	39·8	15·6	19·2	9·5	5·6	1·6
Radio and telecommunications	1951	241·1	129·0	187·7	53·3	61·3	26·5	4·6	2·0
	1955	411·6	217·5	242·2	75·6	104·7	45·8	12·5	5·6

Scottish Radio Retail Wages

The Scottish Radio Retailers' Association has declined to be associated with an agreement governing wages in the Scottish radio retail industry made between the Electrical Contractors' Association of Scotland and the Electrical Trades Union.

Henley Travelling Exhibition

The Henley travelling exhibition has been taken during 1956, and also in previous years, to various convenient centres. The accompanying picture was taken when the exhibition was staged recently at Liverpool, in the Bluecoat Hall, where a large number of visitors attended. It is designed to bring to the notice of electrical engineers the wide ranges of electric wires and cables, joints, terminations, distribution equipment, etc., manufactured by W. T. Henley's Telegraph Works Co., Ltd., and a large selection of representative samples is displayed.

A view of the Henley travelling exhibition

Vitreous Enamelling Development Council

At the first board meeting of the newly formed Vitreous Enamelling Development Council, Mr. S. W. Vickery, managing director of Ferro Enamels, Ltd., was elected chairman of the board of directors.

Plans are now being actively developed for promoting the Council as a representative body for the whole industry. Regional meetings are being planned to explain the aims of the Council and to solicit the widest possible support. Following the regional meetings, a general meeting will be held towards the end of February to elect a further seven directors to complete the board and to launch the active promotion programme which will be co-ordinated from the plans approved by the divisions representing every side of the industry. One of the aims of the Council will be to foster new uses of vitreous enamels and to assist those concerned in gaining the maximum benefit from them.

Equipment for Croydon Technical College

The Croydon Technical College, which is in process of erection, has received from A. Reyrolle & Co., Ltd., a quantity of protection gear on permanent loan, comprising a "Solkor" demonstration panel, two current transformers, two "Solkor" boxes, and five relays mounted on wooden demonstration panels.

Private Automatic Telephone System

A private telephone network which incorporates many novel features and has been specially designed to provide the quickest possible service for the six London ticket booking agencies, which together form the organisation known as Associated Libraries, began operating recently. The "nerve centre" of the new system is a Strowger automatic exchange housed beneath the stage of the Coliseum

Theatre. Among the special facilities the system provides is direct access through dial telephones to any one of fifty West End theatres and other centres of amusement in London.

A clerk wishing to check seat reservations has only to dial the initial letter of the theatre's name followed by two digits (A 12 for the Adelphi). By using this simplified method of routing, delays have been reduced to the minimum. The system is so designed that theatres can communicate only with members of Associated Libraries and not with one another. In addition to giving immediate connection with the leading theatres, the network also enables members of Associated Libraries to communicate with branch offices throughout London, as well as with certain other agencies which, although not full members, are given limited facilities. By dialling "O" after the number required the six full members of the association can break in on an engaged line, whenever it is necessary to pass a message urgently. Before this automatic system, supplied by Communication Systems, Ltd., was installed five operators were required to handle the traffic.

Generating Plant for Newfoundland

The Metropolitan-Vickers Electrical Co., Ltd., has obtained an order for a 20 MW (c.m.e.r.) 3,600 r.p.m. steam turbo-generator set from the Montreal Engineering Co., on behalf of the Newfoundland Light & Power Co. This machine, which will be supplied complete with condensing plant and feed heating and de-aerator equipment, is to be installed at St. John's power station, on the Avalon Peninsula, where it is due to be commissioned in August, 1959. The 20 MW turbine will be a single-cylinder machine taking inlet steam at 850 p.s.i.g. 900 deg F and exhausting to a 14,000 sq ft condenser, which operates at a vacuum of 29½in Hg at the 20 MW continuous maximum economic rating. Steam extracted from the turbine will operate four-stage feed-water heating and de-aerating equipment, giving a final feed-water temperature of 345 deg F. The a.c. generator will be a 25 MVA air-cooled machine, direct driven by the turbine at 3,600 r.p.m. and supplying a.c. at 13·8 kV 60 c/s.

Arts and Crafts Exhibition

The London Electricity Sports and Social Association (Lessa) is staging, on behalf of the London District Joint Advisory Council, an arts and crafts exhibition for employees within the electricity supply industry. The exhibition, at which nearly 1,000 exhibits will be displayed, and which is being sponsored by the London Electricity Board and the London Division of the C.E.A., will be held at the Central Hall, Westminster, on 25th and 26th January. Mrs. Pugh, the wife of Mr. H. V. Pugh, London divisional controller, will present the awards to successful entrants on the second day. Admission to the exhibition will be free and it will be open to the general public as well as to employees in the industry and their friends.

Calendars and Diaries

The calendar of Panelec (Great Britain), Ltd., shows two months on a sheet, each of which has a picture of a building in which the company's floor warming system has been installed.

Some excellent pictures of Scottish beauty spots illustrate the calendar of Scottish Cables, Ltd., each sheet of which shows three months.

A reproduction of "Carnival," by Jules Garnier, makes a colourful picture for the calendar of H. J. Leak & Co., Ltd. The monthly slips show also the preceding and following months.

The calendar of Boxfoldia, Ltd., has monthly sheets with bold figures on a black background.

Monthly cards, showing the preceding and following months, form the desk calendar received from Nalder Bros. & Thompson, Ltd.

An illustration of the Globe Theatre, Southwark, makes an attractive picture for the calendar of Fitter & Poulton, Ltd.

Trade Announcements

In order to co-ordinate and expand the overseas interests of the Edmundsons group of companies, that part of the organisation of the Alliance Wholesale, Ltd., at present carried on by the Export Division has been transferred to a new company known as **Edmundsons Supply Corporation, Ltd.** The head office and accounts will remain for the time being at 24/30, Gillingham Street, London, S.W.1 (telephone: Victoria 8171), the warehouse and stores being at 18, Middle Row, Kensal Road, London, W.10 (telephone: Ladbroke 6531).

Carron Company has appointed Mr. J. H. Thomas as North Midlands representative in succession to the late Mr. W. Rockliff, Mr. T. N. Sargeant as foundries representative in the Eastern Counties in succession to Mr. R. R. Hamilton, who retired at the end of last year, and Mr. J. McCulloch as electrical representative in Scotland in succession to Mr. M. Roughead, who also retired at the end of last year.

The Newcastle sales office of **Brook Motors, Ltd.**, will be moving to larger premises on 8th January at 6, Archbold Terrace, Newcastle-upon-Tyne (telephone: Newcastle 81-1003).

Mr. V. C. Mumford, general sales manager (export), **Hoover, Ltd.**, and the export department which he directs, have moved to 12-15, Hanger Green, Ealing, London, W.5 (telephone: Perivale 8831).

From 1st February the address of **Panelec (Great Britain), Ltd.**, will be 21, Bloomsbury Street, London, W.C.1.

New Series Motors

Crompton Parkinson, Ltd., ask us to explain that the reference in their advertisement on p. 101 of this issue refers to draft B.S. C.W. (Ele.) 6246.

CATALOGUES AND LISTS

LIGHTING FITTINGS.—20-page illustrated catalogue (806/56) dealing with a range of decorative glassware, together with a series of leaflets illustrating a number of new introductions to the company's range of lighting fittings.—**Falk, Stadelmann & Co., Ltd.**, 91, Farringdon Road, London, E.C.1.

Leaflet illustrating and describing a range of watertight wellglass and bulkhead fittings.—**Watertight Fittings, Ltd.**, Victory Works, Chesterfield.

16-page catalogue dealing with the range of "Linolite" lighting fittings and signs, together with a separate price list.—**Linolite, Ltd.**, 118, Baker Street, London, W.1.

Folder illustrating typical wrought-iron products made by the company including lighting fittings of various types.—**Hyders, Ltd.**, Plaxtol, near Sevenoaks, Kent.

Illustrated and priced 20-page catalogue giving particulars of the company's range of fluorescent lighting fittings including vapour proof and garage pit types.—**Strong Electric Corporation (Great Britain), Ltd.**, Whyteleafe, Surrey.

PLUGS AND SOCKETS.—26-page illustrated catalogue covering the range of "Standard" plugs and sockets manufactured by the company.—**Plessey Co., Ltd.**, Electrical Connectors Division, Kembrey Street, Swindon, Wilts.

SPACE HEATING.—Folders dealing with the company's range of oil-filled electric radiators, including domestic, commercial and flameproof types.—**Dimplex, Ltd.**, Millbrook, Southampton.

20-page list giving prices and particulars of electric fires, convectors and other space heating equipment supplied by the company.—**Sun Electrical Co., Ltd.**, 118-124, Charing Cross Road, London, W.C.2.

SWITCHGEAR.—42-page illustrated catalogue dealing with high voltage unit cubicles with draw-out circuit-breakers and a catalogue covering the "BLOCACEC" l.v. distribution centres for indoor and outdoor installations.—**A.C.E.C.**, 56, Victoria Street, London, S.W.1.

Descriptive leaflet (AC156) covering a new range of 30 A and 60 A all insulated double pole a.c. switches and leaflet (P32) describing 30 A surface and flush type insulated switch units with built-in pilot light.—**Bill Switchgear, Ltd.**, Aston Lane, Perry Barr, Birmingham, 20.

TRANSFORMERS. — Folder illustrating and describing various transformers in the company's range.—**Transformer & Electrical Co., Ltd.**, Honywood Road, Basildon, Essex.

WELDING EQUIPMENT.—8-page descriptive booklet (WA/133) dealing with portable a.c. arc welding equipment and a catalogue (WA/132) describing the company's "Speedees" electrodes.—**English Electric Co., Ltd.**, Stafford.

WIRING ACCESSORIES.—84-page illustrated catalogue giving particulars and prices of the company's range of wiring accessories.—**M. K. Electric, Ltd.**, Wakefield Street, Edmonton, London, N.18.

WIRING EQUIPMENT. — Explanatory booklet on the "Portaway" earth-continuity and bonding system.—**Porter Electrical Products, Ltd.**, 2, North Park Road, Harrogate.

Scotland Yard Information Room

A NEW information room has been set up at New Scotland Yard, London, to meet the great increase in "999" calls and to accommodate the mechanically and electrically aided system of working now to be employed. The whole operational unit takes up the greater portion of the ground floor of the North Extension and comprises the information room itself, together with a telegraph office which is the nerve centre of the teleprinter and telex systems, and the urgent communications room, which deals with radio communications with the Continent and special operations such as processional and ceremonial work.

On each of the 14 operators' positions in the information room the switching facilities provide immediate knowledge of the availability of the r/t fleet of up to 30 vehicles per division in 24 divisions (and expansion up to 28 divisions). The telephone facilities at each of the operators' positions provided for the whole of the present lines used for the 999 system together with additional lines, via the private branch exchange, to handle either overflow traffic or traffic coming initially through Whitehall 1212 but referred for emergency purposes.

On the 999 lines flashing indicators draw attention to any call which has not been answered within 30 sec. In addition, there are intercommunication and transfer facilities to allow any particular call to be handled by the inspector or inquiries positions and to give the operator access to other information, including, if necessary, a check back to G.P.O. exchange for the origin of the call. Space has been allowed for expansion of the number of telephone lines at each of the operators' positions. Included in the 999 calls are a large number of automatic burglar alarm installations connected by G.P.O. lines and these involve consulting a cross-referenced index. The utmost reliability in time recording is required for proper and prompt treatment of calls, especially those needing subsequent investigation. Duplicate master clock systems are employed, the main one having seconds as well as half-minute indication.

Conveyor belts are provided to transmit the triplicate message forms from the operators to the fleet indicator positions where a check of the vehicle assignment is made and the appropriate copies are passed on to the r/t operators, "loggist" and telegraph office. The last is only necessary for messages which have to be repeated to police stations as well as to r/t vehicles.

The r/t operator positions, four in the information room and one in the urgent communications room, are all equipped for remote operation via the wireless transmitting and receiving stations and in such a way that any one position can work over one or more channels concurrently. Connections between headquarters and the remote stations are by land lines and, alternatively, radio links. The r/t installation is simplex working with two frequencies for each channel and talk-through facilities when required for messages from car to car. In addition, arrangements have been made with the G.P.O. to interlink, to a limited degree, the r/t and telephone systems. The telegraph office includes a variety of facilities based largely on teleprinter working through the private police network to 97 outstations, but other traffic includes a connection to the United Kingdom telex system.

Large Electric Crane

ONE of the largest hammerhead tower cranes in the world has been made by Werf Gusto of Schiedam and erected at Kawerau, New Zealand, for the Tasman Pulp & Paper Co. Straddling two railway lines, it weighs 225 tons with a full load of logs and runs on tracks at a speed of 200 ft/min. With a 90ft boom, it can lift 30 tons every three minutes, swinging it to the stock piles or sorting tables. The crane is completely electrified, the equipment having been supplied by the Metropolitan-Vickers Electrical Co., Ltd.; it includes ten induction motors from 3 h.p. to 150 h.p., "Stacreep" control gear, and "Perigrip" brakes.

The usual slewing, trolley travel, and hoist motions are fitted with type RW slipring induction motors of 70, 35 and 150 h.p. respectively; the hoisting speed is 50 ft/min with the full load. A motor driven rotating head on the hoist cradle enables the logs to be placed accurately on the stock pile or wagon. There is also an automatic sling release mechanism of the electropneumatic type.

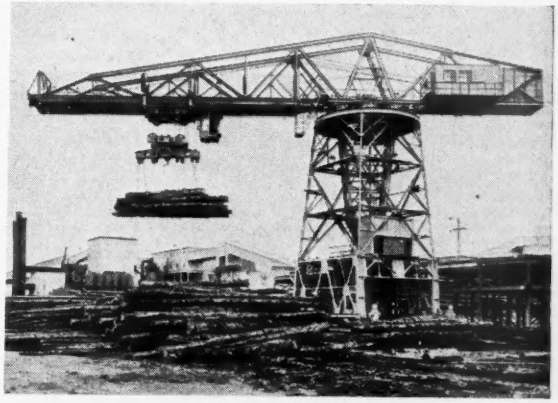
For long travel, the crane is mounted on four bogies, each driven by a 40 h.p. type RW motor. As it is intended eventually to extend the tracks in "U" formation, the track motors are connected in cascade to allow differential action when rounding the bend, and provision has been made to restrict the speed at this point.

The control gear is of the contactor type and is situated partly in the motor house at the end of the boom and partly in the base of the tower. The driver's cabin, which is slung on the travelling trolley 70ft above the ground, contains a control desk provided with master controllers for the four motions. The hoist cradle rotation is controlled by two pedals, and the sling release by a push-button.

Braking is particularly important on a crane of this type, owing to the very large stresses that can be set up by applying the brakes too suddenly. For the hoist motion the "Stacreep" control system employing two brakes has been adopted; these are operated by individual thrustors. On the slewing motor there is one brake, which is released by a thrustor, the return motion of the thrustor being restricted so as to apply the brake very gently. The long-travel motors are provided with "Perigrip" brakes, all four of which are released simultaneously by one thrustor operating through a Lockheed hydraulic mechanism; provision is again made for the brakes to be applied gently to prevent excessive swinging of the load.

An unusual feature is the track-gripping or "storm" brakes, which are applied by means of two type KZ squirrel cage motors of 3 h.p. each; the brakes serve to prevent the crane from running away in the event of the rails being tilted by earthquakes, which sometimes occur in the area. The order for the electrical equipment of this crane was placed through Sandwell & Co., Ltd., of Vancouver, and the Mitchell Engineering Group, London.

Hammerhead tower crane in operation at Kawerau, New Zealand



OVERSEAS ELECTRICAL TRADE

Further Increase in Cable Exports

THE publication of the Board of Trade figures for November shows that, with the December returns still to come, the value of electrical exports for the eleven months of 1956 was already in excess of that for the whole of 1955, in which year record figures were established, and it seems reasonable to assume that the twelve months' total will exceed the 1955 figure by some £30 million. As compared with the preceding month, the value of exports in November, at just over £20 million, was higher by £900,000. The two groups to show the greatest increases were telegraph and telephone material, exports of which in November totalled £2,011,861, as compared with £1,735,854 in October, and cables and wires, the value of which rose from £2,692,053 in October to £3,362,696 in November. There was a slight falling-off in the value of exports of generating plant and motors and of converting machinery, transformers, etc., the figures of £2,825,619 and £2,537,653 in November, comparing with £3,050,412 and £2,432,567 respectively for October.

The most important market for generating plant was India, which imported plant valued at £359,020, South Africa following closely with purchases valued at £326,279; third in order of importance was Australia with a total of £270,223. India was also the principal customer for converting machinery and transformers, taking equip-

TABLE I.—ELECTRICAL EXPORTS

Class	Nov., 1956	Eleven months ended Nov., 1955	Eleven months ended Nov., 1956
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW	151,260	1,293,770	1,581,389
Ditto, 10 to 65 kW	257,875	1,429,673	1,703,627
Ditto, 65 to 200 kW	89,966	1,318,543	1,389,622
Ditto, over 200 kW	228,597	4,711,639	3,233,287
Spark ignition engine driven	10,725	241,443	305,678
Steam turbine driven	49,742	1,348,399	1,141,637
Hydraulic turbine driven	—	368,804	55,114
Other prime mover driven	7,906	310,605	529,254
Generators, not exceeding 200 kW	126,233	1,442,979	1,338,746
Ditto, over 200 kW	138,767	1,172,287	934,470
Parts of generators	368,020	4,691,197	5,262,241
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ½ h.p.	235,378	2,330,571	2,140,967
Over ½ but under 1 h.p.	39,754	728,975	595,559
1 h.p. to 250 h.p.	520,737	4,293,035	4,712,238
Over 250 h.p.	38,406	833,329	765,201
Railway, tramway and trolley-bus motors complete and parts of all motors	203,061	1,753,199	1,809,964
Motor starting and controlling gear	359,192	2,214,704	2,753,489
	2,825,619	30,483,152	30,252,483
Converting machinery	21,249	520,798	335,247
Mercury-arc rectifiers	172,832	767,951	896,776
Transformers for lighting, heating and power (incl. coils)	921,573	9,971,826	11,119,216
Switchgear and switchboards (not telegraph or telephone), up to 200 A and 660 V	346,609	2,935,049	3,196,934
Ditto, other	1,075,390	11,173,358	12,438,016
	2,537,653	25,368,982	27,986,189
Primary batteries:			
Lighting	90,080	816,601	924,273
Radio	287,511	1,947,734	2,870,503
Other	45,588	420,492	471,706
Parts (excl. carbons)	55,522	378,794	441,517
Lamps:			
Filament, exceeding 24 V	93,185	998,834	1,077,784
Ditto, under 24 V	36,890	342,978	344,290
Arc lamps and searchlights	10,594	145,390	211,183
Discharge lamps, fluorescent tubes, etc.	67,610	779,970	805,466
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury arc rectifiers), photo-electric cells, stabilising and cold cathode valves, magnetrons, klystrons	19,941	217,612	273,697
Cathode-ray tubes	61,306	118,436	431,473
Other valves (not X-ray)	243,222	1,985,058	2,395,369
Parts (excluding glass bulbs)	8,599	253,301	114,072
Radio and television transmitters	63,567	663,956	987,476
Commercial radio and radar equipment	1,604,214	11,028,852	14,287,071
Domestic radio receivers, mains	157,937	1,747,090	1,483,697
Ditto, battery	87,846	771,607	812,458
Ditto, other (incl. car)	36,950	211,909	279,252
Radiograms	33,999	486,261	389,658
Television sets	127,161	392,576	571,610
Public address equipment	81,518	869,965	925,682
Sound reproducing app., n.e.s.	44,854	295,716	398,263
Components and parts, n.e.s.	786,557	6,654,687	7,742,741
	3,357,671	25,697,053	31,092,519
Telegraph and telephone installations	782,042	7,136,916	6,817,928
Telephone instruments, separately consigned	183,272	1,081,343	1,596,569
Telegraph and telephone parts	761,752	5,301,957	7,147,141
Line apparatus for long distance commun.	284,795	889,295	2,437,857
	2,011,861	14,409,511	17,999,495

Class	Nov., 1956	Eleven months ended Nov., 1955	Eleven months ended Nov., 1956
	£	£	£
Cookers	84,399	1,223,529	850,860
Toasters	74,748	348,395	356,620
Other cooking apparatus	42,104	339,800	402,818
Parts and accessories	63,881	794,087	855,043
Space heating appliances	38,814	391,026	389,795
Water heating appliances	24,808	376,840	358,066
Other heating appliances	28,941	315,477	387,942
Parts and accessories	69,402	804,327	701,056
Irons	121,189	1,152,922	1,053,534
Arc welding equipment, a.c.	45,681	383,083	574,228
Ditto, d.c.	101,087	316,722	535,042
Resistance welding equipment	10,678	203,949	184,904
Electric furnace plant	70,236	615,015	648,062
Magnetos, ignition	38,272	178,978	312,055
Sparking plugs	218,448	1,716,824	1,918,938
Elec. appliances for aeroplanes, n.e.s.	249,061	2,070,051	2,385,461
Ditto, for motor vehicles, n.e.s.	368,436	3,435,279	3,967,915
Ditto, for cycles, n.e.s.	50,347	778,851	649,607
Signalling app. (incl. traffic signals)	99,615	557,395	772,137
Industrial radio-frequency equipment	13,960	167,947	136,023
Bell app. (not telegraphic or telephonic)	14,079	95,946	102,063
Instruments, commercial	166,684	1,621,735	1,902,602
House service meters (including parts)	160,685	1,445,585	1,862,063
Electro-medical apparatus (not X-ray)	57,735	548,395	695,987
X-ray apparatus (excl. tubes and valves)	56,677	693,912	701,499
Vacuum tubes	39,538	243,690	324,242
Ceiling fans, complete	84,353	907,060	1,129,861
Desk fans, complete and parts of desk and ceiling fans	48,711	342,992	438,719
Vacuum cleaners	134,116	1,416,597	1,574,751
Floor polishers	84,779	1,061,475	838,399
Food mixers	46,454	591,676	655,362
Hair clippers and dry shavers	133,666	1,017,801	877,412
Other portable appliances	28,539	449,787	319,304
Parts	146,824	956,665	1,265,767
Portable elec. tools (not saws) and parts	221,176	2,090,957	2,420,501
Cables and wires:			
Telegraph and telephone, submarine	249,365	836,703	1,936,482
Ditto, other	989,604	5,731,317	9,308,319
Cotton, silk or art. silk insulated	44,253	548,589	540,696
Enamel, glass or asbestos insulated	127,519	826,115	1,132,677
Paper insulated	903,108	8,622,931	9,931,155
Rubber insulated	634,488	5,234,169	5,943,182
Thermoplastic insulated	177,875	954,162	1,611,651
Other	236,484	2,253,953	2,384,704
	3,362,696	25,007,939	32,788,866
Accumulators for motor vehicles	116,063	1,758,226	1,677,311
Ditto, traction	34,966	203,974	336,677
Ditto, radio and other portable	102,685	664,847	962,022
Ditto, other	48,922	367,950	716,966
Parts and accessories	105,352	1,051,854	1,066,598
Elec. porcelain, etc. (incl. insulators)	118,735	1,010,100	1,241,614
Insulating cloth and tape	57,688	692,790	676,197
Other insulating material	81,274	1,084,254	1,088,090
Permanent magnets	56,005	498,068	516,047
Radio, telegraph and telephone testing equipment, n.e.s.	33,367	414,315	458,245
Scientific elec. instruments (not telegraphic or telephonic):			
Time recorders and time switches, complete	9,604	272,886	157,941
Other	248,259	2,409,694	2,442,084
Electrical machinery, n.e.s.	79,732	1,140,676	1,210,355
Electrical apparatus and appliances, n.e.s.	951,959	6,840,349	8,678,099
TOTAL	20,065,214	174,862,183	201,043, 58

TABLE II.—DISTRIBUTION OF EXPORTS OF ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES

Country	Nov., 1956	Eleven months ended Nov., 1955	Eleven months ended Nov., 1956	Country	Nov., 1956	Eleven months ended Nov., 1955	Eleven months ended Nov., 1956
	£	£	£		£	£	£
Channel Islands	159,638	764,795	911,677	Western Germany	268,243	1,929,335	2,013,618
Gibraltar	15,284	177,358	398,020	Netherlands	1,110,388	6,200,325	7,566,866
Malta and Gozo	91,645	502,046	776,265	Belgium	219,628	2,660,675	3,091,545
Cyprus	156,150	1,059,380	1,474,386	France	369,065	2,864,443	3,950,896
Sierra Leone	18,732	230,044	272,018	Switzerland	127,405	1,023,026	1,123,383
Gold Coast	122,437	1,648,422	1,513,640	Portugal	298,538	2,059,035	1,976,406
Nigeria	283,497	2,859,809	3,141,609	Spain	525,134	1,492,824	4,477,960
Union of South Africa	1,527,318	16,392,435	14,455,388	Italy	283,478	2,628,697	3,112,385
Rhodesia and Nyasaland	470,867	4,981,108	5,471,467	Austria	55,827	492,951	441,625
Tanganyika	97,580	970,177	629,953	Yugoslavia	36,250	625,639	498,480
Kenya	313,091	1,899,855	2,670,638	Greece	151,392	1,125,237	2,323,097
Uganda	94,524	1,086,265	807,991	Turkey	52,394	1,039,847	745,573
Anglo-Egyptian Sudan	85,849	828,205	811,030	Belgian Congo	37,919	291,001	324,647
Mauritius	45,885	317,799	273,321	French Morocco	72,863	341,409	510,003
Aden	50,805	459,742	515,792	Portuguese East Africa	22,076	218,062	244,724
Bahrain, Qatar and Trucial States	64,590	859,231	937,216	Egypt	71,725	1,531,245	1,723,436
Kuwait	189,837	997,407	1,550,221	Libya	28,703	187,642	298,879
India	1,669,458	14,832,384	19,689,039	Syria	43,979	326,424	723,985
Pakistan	315,912	3,479,188	3,381,579	Lebanon	38,882	378,321	622,335
Singapore	516,895	3,452,287	3,595,957	Israel	96,585	436,302	973,156
Federation of Malaya	262,625	2,645,581	3,002,857	Jordan	20,794	385,595	537,774
Ceylon	227,588	1,329,569	2,099,540	Saudi Arabia	133,555	818,789	1,354,551
British North Borneo	10,761	222,046	248,585	Iraq	137,992	2,296,960	3,089,848
Sarawak	22,433	169,533	175,247	Iran	254,243	812,090	2,052,516
Hong Kong	318,673	1,874,211	2,571,954	Burma	65,105	1,663,954	1,194,046
Australia	1,647,255	19,244,726	20,125,153	Thailand	108,162	1,582,564	981,611
New Zealand	1,145,907	11,330,267	9,831,180	Indonesia	55,566	342,924	570,809
Fiji	18,472	205,758	233,475	Japan	42,523	994,494	705,252
Canada	1,197,839	7,515,753	12,138,266	United States	839,272	4,806,625	8,505,467
Jamaica	89,967	987,502	1,063,352	Cuba	44,190	262,948	403,834
Barbados	16,954	219,697	254,622	Mexico	34,977	420,378	749,039
Trinidad	81,614	1,003,810	1,079,569	Colombia	111,848	852,977	892,097
British Guiana	42,605	504,627	427,254	Venezuela	239,504	2,276,693	2,873,849
Other Commonwealth countries	130,501	1,231,134	1,033,610	Peru	134,742	416,916	674,024
Irish Republic	271,415	3,710,366	3,137,847	Chile	53,615	289,026	389,495
Soviet Union	146,154	3,188,813	2,320,127	Brazil	102,844	721,260	1,627,149
Finland	262,101	1,446,599	1,770,998	Uruguay	8,907	356,320	110,319
Sweden	587,052	3,753,549	3,999,537	Argentine Republic	74,632	1,588,093	862,612
Norway	340,445	3,264,216	2,501,050	Other foreign countries	365,129	2,471,070	2,895,701
Iceland	14,611	145,963	160,052				
Denmark	194,419	1,647,483	2,079,816	TOTAL	20,065,214	174,862,183	201,043,158
Poland	7,755	210,927	298,868				

ment valued at £492,539. South Africa held second place with imports valued at £285,769, Canada being third with £285,418, and Australia fourth with a total of £274,568.

The Netherlands was by far the best market for radio and electronic apparatus, its purchases totalling £515,622. Other important buyers were Australia (£282,504) and Canada (£252,774). New Zealand took the lead in the telegraph and telephone equipment group, taking apparatus valued at £270,447, second place being occupied by Australia with imports of £252,466. Outside the Commonwealth countries the main purchaser was Portugal which took equipment worth £199,108.

India maintained its lead as the best market for cables and wires with imports of £278,506. Other markets in order of importance were Singapore (£267,680), New Zealand (£263,687) and South Africa (£205,185).

The principal items of electrical equipment and apparatus are shown in Table I, but in addition, the following apparatus is shown separately in the returns:—

Electrically operated washing machines, complete, not exceeding 150 lb net weight: November, £338,451; eleven months, £3,305,897. Ditto, 150-250 lb net weight: November, £91,347; eleven months, £1,130,564. Parts: November, £64,813; eleven months, £758,515.

Electric light fittings and lanterns, complete, with or without bulbs (excluding arc lamps, searchlights and cycle lamps): November, £181,535; eleven months, £1,625,409. All other electric lighting appliances: November, £356,322; eleven months, £3,579,700.

Electric carbons, including parts: November, £42,166; eleven months, £537,995.

Welding electrodes (excluding carbon), covered: November, £124,545; eleven months, £1,245,567.

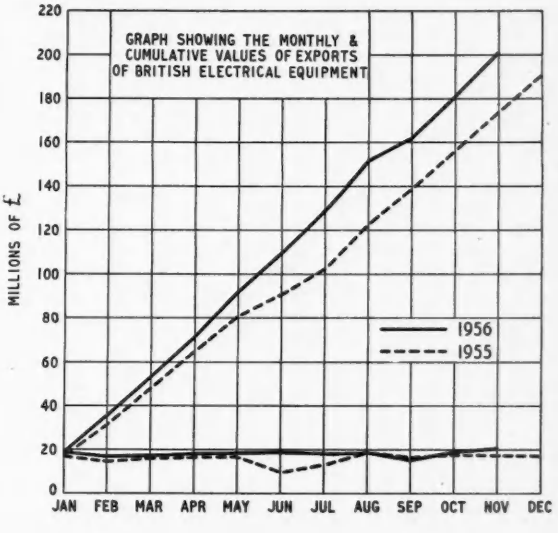
Electric conduit tubes and cased tubes: November, £122,634; eleven months, £844,628.

Electric locomotives: November, £400,727; eleven months, £2,679,532. I.c. engine locomotives with electrical transmission: November, £448,778; eleven months, £7,977,399.

The distribution of exports of the classes of electrical machinery and apparatus shown in Table I is indicated in Table II.

Electrical Imports

The value of imports of electrical equipment was slightly higher in November at £2,265,379, as compared with the October figure of £2,224,590, and the total for the eleven months of £21,860,625, compares with £21,597,823 for January-November, 1955. Once again the leading supplier was the United States, which delivered goods valued at £733,131, Western Germany being second with £352,151, and the Netherlands third with £309,473. Radio and electronic apparatus continued as the principal class of imports.



Controlled

Use of Rotary Amplifiers for Voltage, Speed, Current & Power Factor Control

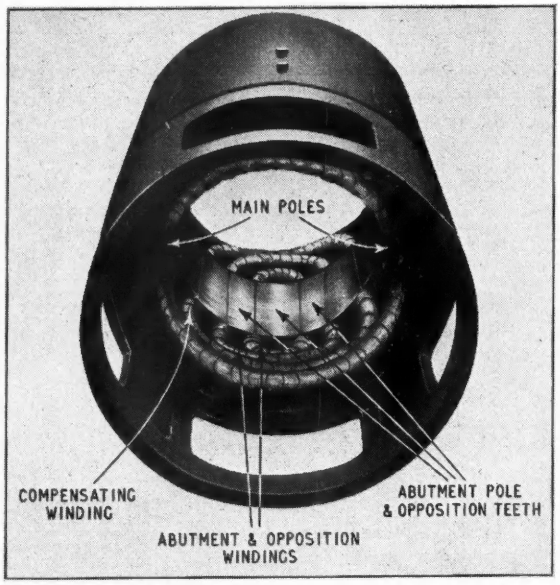


Fig. 1.—Arrangement of field windings in the "Magnicon" exciter

THERE is an ever-growing need for automatic or semi-automatic control of the output of dynamo-electric machines, and for this reason there is an increasing requirement for generators and motors which are inherently fast in action. In addition, for field forcing for high speed and rigidity it has often been found desirable to use amplifying apparatus for excitation so that the control can be effected by small power circuits. The amplifiers are usually of the rotating type and these may be further divided into cross-field generators, in which armature reaction is used to excite a second stage, and machines with heterogeneous pole systems in which currents generated at one pole frequency are used to excite a pole system with a different number of poles. Of rotating amplifiers probably the most used are the cross-field types, Amplidynes and Magnicons, and only these are considered below.

The Amplidyne is a special arrangement of the Rosenberg dynamo having, as is usual with these, a full span armature winding of 180 electrical degrees; the Magnicon is provided with a half-span armature winding of 90 electrical degrees and this simple provision makes a profound difference in the possible operating characteristics of the two machines.

As is usual with dynamo-electric machinery a reduction in the span of the armature coil involves a loss of armature output to the extent of $\sqrt{\text{span}}$ (in this case down to 0·71), that is, if the same output is desired from both machines the half-span armature core volume (D^2L) must be increased by 41 per cent. If, for example, the core dimensions of the full-span unit were $6\frac{1}{2}$in diameter by 3in long the corresponding half-span dimensions would be $6\frac{1}{2}$in diameter by $4\frac{1}{4}$in long and this would appear at first sight to be a serious fault. However, shortening the span has so many other advantages that the loss of output per unit of core volume is a relatively small matter. Some of these advantages are as follows:—

Firstly, the shorter span of the armature coils enables the overlap of the end windings to be about 35 per cent shorter and, apart from saving copper, the length of the ends of the armature windings and the length of the machine generally will usually be less in practice for the same output. The field windings, because there is no overlapping and the m.m.f. of the compensating winding is less, will occupy considerably smaller radial depth; this means less field copper (or the equivalent in field losses) and smaller frame diameters when compared with full-span units of corresponding outputs. Generally, it may be claimed that, although the core volume of the half-span unit may be larger for the same output, the overall dimensions are likely to be less than those of the full-span unit.

Secondly, the greatest advantage lies in the freedom to design the control axis so that the system is internally self stabilising; also complete control is simply obtained with the use of one electric circuit by using opposing m.m.f.s produced by this circuit, one of which operates on a magnetically saturated or non-linear part-pole, the other on a non-saturated linear part-pole. This arrangement is not possible with the full-span unit where the control and main fluxes are mixed up in each pole. Usually with the full-span machine, control is obtained from an external source and is non-rigid, necessitating anti-hunt auxiliary apparatus, whereas in the short-span unit stabilisation is rigid and anti-hunt apparatus is unnecessary.

Thirdly, the m.m.f. of armature reaction is uniformly directed on to the operating poles in all directions ensuring that the magnetising m.m.f.s in both axes operate at maximum efficiency.

The accompanying table gives an approximate comparison of weights and sizes, based on the core sizes already given for equal outputs, but neglecting the auxiliary apparatus required by the full-span type unit for supplying the reference power and anti-hunt gear.

Fig. 1 illustrates the simplicity of the short-span unit and also that the stator windings have small mean lengths and do not overlap each other. In both machines tests show that stray currents exist, especially under the cross

Mechanical Comparison	Full-span Winding	Half-span Winding
ARMATURE:		
Armature diameter	1	1
Armature core length	1	1·41
Overhang of armature and windings	1	0·65
Total length of formed armature coils	1	0·7
Overall length of machine	1	0·88
STATOR:		
Outside diameter of stator disc ...	1	0·9
M.m.f. of compensating coils ...	1	0·6
Approximate overall diameter of machine	1	0·9
Approximate total weight of stampings	1	1·15
Approximate total weight of copper	1	0·85
GENERAL:		
Brush gear and commutator ...	1	1
*Approximate overall cubage ...	1	0·8
*Approximate overall weight ...	1	0·95
*Approximate overall cost	1	0·95

* Without ancillary apparatus, not necessary with half-span unit.

Excitation

By J. C. MACFARLANE, O.B.E., Wh.Sc., M.I.E.E.*
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axis brushes and that the m.m.f.s due to these sometimes do make quite a difference on the final output of the exciter. It is the usual practice to make the excitation brushes circumferentially as narrow as possible and of special quality because the stray m.m.f.s are directly affected by the brush width and long-term regulation by the type of wear that takes place both in these brushes and the commutator after long periods of running. However, where this type of generator is used for alternator excitation a voltage variation of less than plus or minus 2½ per cent is easily obtained up to quite large sizes without the use of interpoles.

For larger machines (say, 250 kVA and upwards) interpole windings might be added unless some form of assisted excitation is available to keep the exciter size down and enable it to be designed to perform its chief function satisfactorily, that is, as a stabiliser for the system.

Power to assist the stabiliser or to reduce the magnetising power required can be made available in several ways. In the first of these systems separate field windings may be supplied from the main machine terminals, through a rectifier if necessary; alternatively, the stabilising exciter may operate as a booster in series with a single set of windings, avoiding the necessity for duplication. A second way is for separate field windings to be supplied from a separate d.c. source, if available. The rotors of small alternators are often fitted with starting windings which are also used for trickle charging a battery and this source may also assist the stabilising exciter. Thirdly, condensers may be used to make the alternator armature self-exciting, variable conditions such as those due to load, power factor, and other changes being taken care of by the stabiliser.

Under the fourth system, the design of the main generators, particularly if they are d.c. machines, may have a large effect on the capacity required for excitation, for instance:—

(*a*) Very small magnetising m.m.f.s are required for constant voltage variable speed d.c. generators used for ungoverned water turbine drives if they are designed with large electric/magnetic loading ratios, and provided with a complete compensating winding and small air gaps.

(*b*) The remarks under (*a*) apply equally to exciters used with larger generators where the system is large enough to make main and pilot exciters economical.

(*c*) The field systems of d.c. welding generators, particularly of the drooping characteristic or self-regulating type, require careful design for very fast operation.

Considering the first system it may be possible to reduce the size of the stabiliser to one-fourth of that required for full excitation by arranging the self-excited field to take three-fourths of the total field power loss and the stabiliser the remainder. For example, a 10 kVA three-phase generator operating on full load at 0·8 power factor may absorb a total of 400 field watts, 300 being supplied by self-excitation through a suitable rectifier at, say, 220 V. A twelve-plate selenium rectifier carrying 1½ A would provide this and also a small extra d.c. supply required for the control coils of the stabiliser. Unless well ventilated this rectifier will be comparatively large and as two small adjusting and stabilising resistances are also required a control box or casing becomes necessary.

Generators constructed under the second system will not usually require rectifying apparatus. In alternators up to about 15 kVA three-phase (10 kVA single-phase) self-starting from a 24 V battery is frequently adopted, often by the use of an auxiliary d.c. armature winding mounted on the alternator core. The additional d.c. supply may be conveniently used not only for the self-starting of the set but also for battery charging; assisted magnetisation of the main field thereby reducing the stabilising exciter size; and for simplification of the control gear.

The d.c. e.m.f. is available at 40/45 V and a trickle charge is maintained by means of a permanent resistance of suitable value.

The auxiliary excitation usually supplies, completely, the light load excitation of the alternator and leaves the stabiliser to deal with the back m.m.f. of armature reaction of the alternator which occurs due to load and power factor changes. The stabiliser then becomes so small (not appreciably exceeding a capacity of 100 W within the above range of output) that it can be mounted on a taper extension of the alternator shaft.

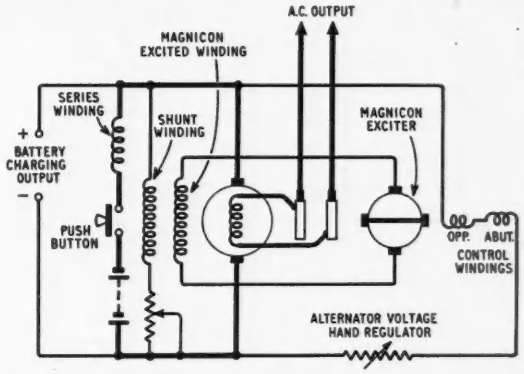


Fig. 2.—Alternator with assisted magnetisation and d.c. starting and charging windings

The control gear is simple as due to the existence of a d.c. e.m.f., voltage detection circuits are unnecessary and inspection of the line diagram Fig. 2 shows that apart from starting and battery charging no external connections (except for the power output terminals) are necessary provided the generator is set for a fixed output. If desired a small voltage range can be provided by means of a regulator in the stabilising control circuit and this involves only one more external connection.

Regulation

For three-phase generation a regulation of ± 2½ per cent is practicable from no load to full kVA at any power factor from unity to 0·8 but close regulation is more difficult to obtain with single-phase generation due to the concentration of kVA in one phase. Under the above conditions + or − 3½ per cent is reasonably practicable. The reasons for this difference can be indicated by an example, viz. a three-phase 10 kVA, 400 V star-connected generator carries at full kVA 14½ A in each phase. The equivalent single-phase unit has a capacity of two-thirds of 10 kVA, viz. 6·7 kVA and the current in one phase when operating as a 230 V single-phase unit will be 29 A, that is, double

* The Macfarlane Engineering Co., Ltd., Glasgow.

that in each of the phases of the three-phase generator of equivalent capacity.

The difference of reactance voltage between the two types of generator of equivalent output is clearly indicated by the voltage generated on the d.c. winding under similar loading conditions.

When each generator is set to give the same regulation under similar power factor and loading conditions it is found that the terminal voltage of the d.c. side is higher on equivalent load in the single-phase machine.

In the example quoted if each unit is set to compound level at 10 kVA three-phase, 6·7 kVA single-phase, 0·8 p.f. the commutator voltages rise by about 6 per cent and 12 per cent respectively, indicating that the work the stabiliser has to do controlling the single-phase generator is the greater because of the greater reactance voltage it has to overcome. Since the d.c. e.m.f. generated in the starting winding becomes greater with increasing load, the terminal voltage also increases and helps to compound the alternator through the field winding which it supplies; this further eases the work of the small exciter. Good temperature compensation is obtained with these generators since the stabiliser voltage rises with increase in the stabiliser control winding temperature whereas the auxiliary field m.m.f. falls with rising temperature.

In addition to self-starting and battery charging, the second system has advantages over the first in that no rectifiers of any kind are necessary, the control gear is very simple and the stabiliser size is the minimum.

The third system will, in many respects, be similar to the example just described for the m.m.f. of the field coils supplied from the starting armature will be replaced directly by a leading m.m.f. provided by current flowing in the armature windings, and the corresponding field winding will not be required. By using up the space vacated, additional copper can be used to reduce the power required for magnetising the stabiliser field. For single-phase generators it would be desirable to provide efficient amortisseur action.

Advantages of Fourth System

In dealing with the fourth system reference may be made to a paper* read by the authors before the Institution of Electrical Engineers in which it was indicated that for rigidity and rapidity of control completely laminated and compensated generators were necessary. It was also shown that in constant voltage generators in which the flux remained appreciably constant, for the same output (or D^2L), the armature core should be small in diameter, long, and the magnetic/electric loading ratio retained at the maximum; whereas for constant current generators in which the flux varied continuously with the load, exactly the reverse conditions should apply.

Laminated compensated dynamo construction can be readily obtained by using normal induction motor stators, preferably with correspondingly larger slots, and complete compensation is obtained by a fully distributed winding, the field winding being wound into the same slots.

Advantages gained by this system over the salient pole non-compensated type are as follows:—

(*a*) The airgap length is limited only by mechanical considerations.

(*b*) Small air gaps mean small field strengths (down to about one-third that of the corresponding salient pole generator with the same armature).

(*c*) Speed of response to rapid changes of load (requiring field changes) is greatly improved because the time constant of the field winding is much reduced.

* Macfarlane, "Direct Current Arc Welding Generators and Systems," 2nd May, 1946, Section 3.3.3.

(*d*) Magnetic/electric loading ratios may be reduced as much as 100 per cent making the final field strength, as in (*b*), as low as one-sixth that of the corresponding salient pole unit. This in turn (provided the space taken up for field copper in the two units is equal) involves a reduction of power required in the field to one-thirty-sixth part.

(*e*) The pole arc/pitch ratio may be greater.

(*f*) Perfect commutation is obtained with $2\frac{1}{2}$ to 7 per cent extra m.m.f. on the interpole axis. The m.m.f. of the compensating winding need therefore only be 80 per cent of that of the normal interpole coil. Due to this although the mean length of the distributed compensated coil will be approximately twice that of the concentrated interpole coil, with equal conductor sections the loss ratio will be about 1·35/1 resulting in a 10 per cent increase of the series circuit loss, which will be more than balanced by the reduction of other losses obtained.

(*g*) Reduced remanent magnetism and eddy currents.

With further reference to speed of response and rigidity of control a brief comparison can be made between the two generators A (salient pole) and B (laminated field) by means of the usual methods.

The time taken by the current to rise in a field coil to 90 per cent of its full value $\left(\frac{E}{R}\right)$, after sudden application of E to its terminals, is proportional to the product of the resulting flux passing through the coil and the m.m.f. producing it, and inversely proportional to the power waste in the coil.

Assume that there is space on the stator of B for sufficient copper to produce the necessary m.m.f. and to consume one-sixth of the field power of that required by the salient pole machine A, then the exciter required by B would be only one-sixth of the size, and the time to build the field to 90 per cent of its full value would only be one-half that required by A. By using an exciter on generator B having a transient capacity equal to that of the salient pole machine, that is, a machine which would give, transiently, a terminal voltage six times greater than the static or normal full load value, response and rigidity are improved as follows:—

Generator	A	B
Main generator size (D^2L)	1	1
Exciter (D^2L)	1	1
Exciter ceiling	1	6
Rigidity of control	1	6
Rapidity of response	1	12

It may be noted that a sudden departure from normal

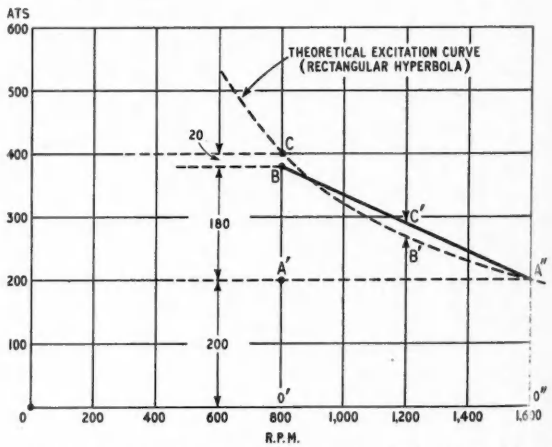


Fig. 3.—Excitation diagram for d.c. constant variable speed turbine generator

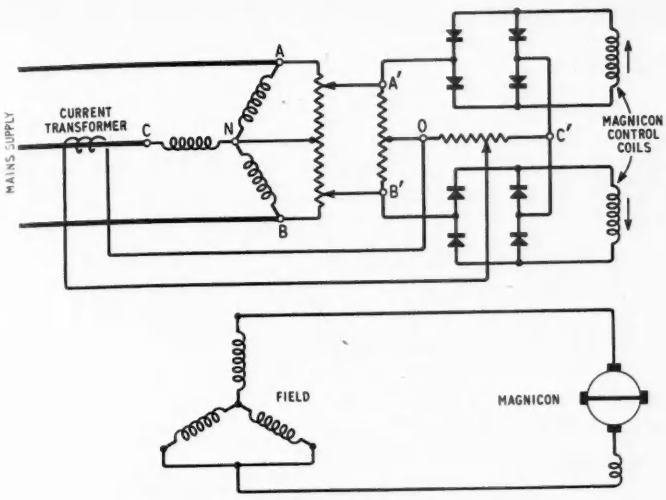


Fig. 4.—Auto-synchronous motor with p.f. control

will tend to create a restoring force six times, and a speed of re-adjustment 12 times, as great in machine B as in A. Further, by altering the armature core D/L proportions, while maintaining constant output (D^2L), still better results will be obtained.

Consider in more detail the control of the output voltage of the d.c. generator example (*a*) of the fourth system described, driven by an ungoverned water turbine having a theoretical speed ratio of 2/1 and with the load increasing in direct proportion to the speed drop and reaching a maximum at half speed. In this case assume it is desired to keep the voltage constant over the speed and load range. It is obvious that the excitation of the generator must vary in inverse proportion to the speed, that is, a curve of excitation drawn to a base of speed will be a rectangular hyperbola as shown in Fig. 3 as CB′A″. The main generator is provided with a shunt winding across its brushes having a sufficient m.m.f. to supply the top speed magnetisation O″A″=O′A′. Since the generator output or controlled voltage is constant this m.m.f. is also constant. Compounding is represented by the line A″C′B and, if the machine is of the laminated compensated construction, this effect may be obtained by setting the generator brushes slightly against the direction of rotation of the machine from the neutral axis.

The remainder of the excitation required to produce the theoretical curve is supplied continuously by the stabiliser to the small stabilising winding on the poles of the main generator. The control circuit of the stabiliser is coupled as usual across the output terminals of the main generator. This excitation rises to a maximum positive and negative value of 20 ampere-turns in the case being considered at half speed BC and three-quarter speed B′O′ respectively. Thus, the stabiliser need only deal with plus or minus 5 per cent of the total maximum excitation. The m.m.f.s indicated on Fig. 3 are for a water turbine generator of 10 kW output and for a laminated compensated type main generator. By the use of this type of generator, as already indicated, the magnetising m.m.f.s become very small and under these conditions, with the stabiliser having a ceiling e.m.f. of ten times that required at its continuous rating, the stabiliser would be of about 50 W capacity and the circuit e.m.f. would be held rigidly by this means at the desired value.

It may be noted from Fig. 3 that the stabiliser when controlling throughout the whole speed range acts as a reversible booster, but for close control, the remanent magnetic effects of its power axis may be large enough to cause considerable disturbances. In this event it becomes desirable to adjust the e.m.f.s and stabiliser size so that it operates in one direction only.

Example (*b*) of the fourth system is in common use and if designed to take advantage of all the points already outlined excellent results in regard to rigidity and rapidity of control are available with an extremely small stabiliser. For example, a four-pole 50 c/s generator of 100 kVA capacity would have its field supplied by a laminated compensated copper type d.c. generator of otherwise conventional design having a field winding (supplied by a stabiliser) which only required 20 W for excitation at normal full load. To ensure a reasonable rigidity of working of generator plants up to overload capacities of 50 per cent or more the transient capacities of the exciters would preferably be twice, and that of the stabiliser two-and-a-half times that of the normal, that is, for the example discussed, 50 W.

For large low-speed generators it is usually preferable to drive the exciters independently and this is convenient with the system discussed. Single carcase units, that is, with the motors and generators within the same frame, are convenient and, with the system described, rigid paralleling of the generators is effected by paralleling either the compensating windings on the stabilisers or on the exciters. The links between these windings carry very small currents in either case. Voltage control gear of a few watts only, for each stabiliser, is all that is required to adjust each alternator.

In example (*c*) of the fourth system the important class of self-regulating arc welding generators is mentioned. Due to the peculiarities of the transfer of metal taking place as it does from the electrode to the work in the form of drops which short-circuit the arc, great rapidity of response must be an essential feature of these generators, and field design should follow the principles laid down above.

The arc voltage drop is not uniform across a metal arc, most of the drop occurring close to the ends leaving only, if the gap is short, a small remainder across the arc stream. For stable working minimum arc length is determined by the diameters of the metal drops and these are controlled, to a large extent, by the pinch effect of the transient current passing at the time of short circuit. Obviously, the smaller the drops the better, and therefore for the same average powers the transient short-circuit currents should be as large as possible. Some of the advantages of short arc working are increased metal penetration, and smaller arc stream contamination, arc blow, power waste and time to restore arc e.m.f. for full welding. To ensure sufficient recovery speed a recent tendency to use rectifier apparatus has become apparent but, by designing along the lines already indicated, welding generators have been produced, competitive in first and maintenance costs, equal in recovery speeds and in addition, having satisfactory overshoot capacities to reduce metal drop sizes. The heat capacity of generator armatures is many times greater than that of rectifier plates, making the rotary apparatus much less delicate to handle.

Power Factor

Auto-synchronous or synchronous induction motors have a considerable field of application but their use in the past to provide reactive kVA for system power factor correction was, in most applications, economically wrong.

Where large pull-out torques were required it was usual to design the motor to operate at leading power factor at light load (often as low as 0·6) the available reactive kVA being used to supply magnetisation to the line.

This practice meant motors which were from 30 to 50 per cent heavier than a motor which would provide the same pull-out torque and operate at approximately unity power factor throughout its whole load range. This subject was dealt with by one of the authors in the discussion on the Rudra and Walker paper on the performance of phase advancers (*Journal*, I.E.E., Vol. 69, page 477, 1931) where it was suggested that by use of a current transformer and metal rectifier, an exciter (of the type now known as the " Rototrol ") could be controlled to keep the power constant as the load varied.

These requirements have also been met in a modern manner by using a cross-field exciter to supply the synchronous-induction motor field, the exciter being controlled in turn by a power-factor-sensitive circuit. One circuit which has been used with the " Magnicon " is shown in Fig. 4.

The control circuit is supplied from a potentiometer coupled across the AB lines of the supply and from a current transformer in the third line. By varying the potentiometer tappings, voltages of varying power factor can be supplied to centre tapped resistor A′OB′. The c.t. secondary is tapped across resistor OC′, and the resultant voltages A′C′ and B′C′ are rectified and the resultants fed to opposed control coils on the Magnicon.

If control to unity power factor only, is required, the potentiometer is not needed and A′ and B′ can be coupled directly to A and B. Under this condition voltages A′C′ and B′C′ will be equal when the motor draws unity power factor currents and will differ if the power factor changes. The unbalance of the control coils so obtained causes an amplified correcting injection into the main field.

Similarly, if the potentiometer tappings are altered control to power factors other than unity can be obtained.

Finally, if the centre tapping point O of resistance A′B′ is moved so that voltage A′O is not equal to voltage OB′ then the reactive current drawn by the motor is altered from the minimum (unity power factor) value by a fixed amount independent of the load. By this adjustment, therefore, a controlled amount of kVAr can be drawn from the line.

The examples of controlled excitation given are typical of many similar applications. In general, for work other than that of the highest precision, rotating amplifiers will often provide the simplest and cheapest form of field forcing. For best results it is usually desirable to consider the field system of the machine being forced, as proper design of the main machine may make a profound difference to the size of the exciter and the speed of response and rigidity of the system. In fact, by suitable design proportions the main generator may often be made sufficiently fast in action without external forcing means; a typical example of this is the welder generator which is described above.

The Fuel Situation

IN his presidential address to the Junior Institution of Engineers Mr. Bryan Donkin emphasised that the best fuel economy in the production of energy could be achieved only by attacking the problem from a number of directions. The pressing need for economy was illustrated by the growth of the demand for energy in the form of electricity, which had since 1920 doubled every 8·3 years in the United Kingdom and showed no signs of diminishing.

Electricity did not, however, provide a fair measure of the rate of increase of the total energy demand, since the increase in its use was largely at the expense of other forms. Railway electrification, for instance, actually reduced the total national demand for energy. Nevertheless such savings were not enough to offset the rapid increase in ton-mileage of transport by all means. Other examples were the growing production of synthetic substances, which called for increasing quantities of process steam, while the conversion of ores to metals in furnaces grew year by year, as did the demand for more power in manufacturing industries. Also the rising standards of comfort and efficiency called for constant improvement in heating and lighting.

In 1914 the output of coal, when the national demand for energy was far less, was 290 million tons, permitting an export of 87 million tons, whereas in 1955 the amount was 224 million tons, with a rough balance between exports and imports, so that 28 million tons of oil had to be imported against 2 million in 1938. Moreover the average calorific value of coal had fallen and power stations, which took about one-fifth of the total production, generally burned low-grade coal unusable for any other purpose.

Hydro-electric power produced in the United Kingdom in 1955 (more than half of that available) met only 1·65 per cent of the total demand. Even if the exploitation of the Severn tides became economical, the 2,200 million kWh per annum expected would represent only 2·8 of the total consumption of electrical energy in 1955, i.e. one-third of the increase in demand from 1955 to 1956. Wind power and solar power could afford little relief.

The only alternative to " fossil " fuel appeared to be the exploitation of nuclear fission of uranium, the cost of which per unit of energy was lower than that of coal. Mr. Donkin then outlined the principles of nuclear fission and their application to the generation of electricity. Finality in design, he believed, had by no means been reached and the evolution of the best types would take time.

Turning to Government sponsored help with fuel economy, he briefly referred to the fuel efficiency loan scheme (under which £3 million had been advanced since 1952), the National Fuel Efficiency Service, formed to give advice to industrial concerns, and the British Coal Utilisation Research Association. A survey by N.I.F.E.S. had shown that a fuel saving of over 15 per cent was possible through better operation of boilers as an average and up to 30 per cent in some factories. This saving could be made mainly by a more extensive use of mechanical stokers, better heat insulation, more instrumentation and the training of boiler-house staffs. A City and Guilds examination for a boiler operator's certificate was initiated in 1953.

Where a demand existed for large quantities of heat within a short distance from a power station the energy dissipated at about 100 deg F in condensing water could be saved by rejection at a higher temperature as process steam for industry, thereby reducing waste energy from perhaps 75 to 20 per cent. An example was at the C.E.A. Spondon power station (Derby) where up to 600 klb/hr of process steam was supplied to an adjacent industrial firm. Combined electricity and heat production, which required two steam pressures, also saved capital expenditure by the elimination of the low-pressure boiler, although there were counterbalancing costs and complications when applied to a large power station. The most favourable condition occurred with a private power plant designed to provide both services. Combined heat and electricity generation could also be adapted to domestic space heating (which took about a third of the coal consumed in the United Kingdom) as in the Pimlico housing scheme, of which general particulars were given. A somewhat different type of scheme at Munich was also described.

MATERIALS FOR THE ELECTRICAL INDUSTRY

Trend of Production and Prices in 1956

In this survey, especially prepared for us by the Metal Information Bureau, Ltd., particulars are given of the factors which have influenced the production, consumption and prices of the principal materials employed in the production of electrical equipment during the past year.

COPPER.—The past year will probably long remain in the minds of all interested in copper as one of outstanding developments. Thanks to a very high level of world demand and a supply situation aggravated by a serious strike at big Chilean mines, 1956 started with prices around £400 a ton—a level far above anything which even the most bullish-minded observer of copper would have regarded as fantastic a year or two previously. With a strike at an important American refinery the shortage was rendered more acute and although in the United Kingdom open market consumer demand was not at a high level, prices continued to climb until they reached in March the record height of £437 a ton.

Such price levels, and the rapidity with which prices have moved in recent years, have no friends either on the producing or consuming side of the industry, but although the leading American producers struggled manfully to hold prices in check by stabilising their selling price at 46 cents per lb (£368 per ton), even when open market quotations in America were almost £100 a ton higher, the inexorable pressure of demand resulted in most consumers having to pay extremely high prices for their metal.

The inevitable result, and the one which producers generally increasingly feared, was that added impetus was given to a world-wide move to substitute aluminium and other materials for copper where possible. Undoubtedly, a good deal of progress was made in this direction, but as prices subsequently fell away sharply from their peak, the economic pressure for substitutes lessened and by the end of the year when prices on the London market were again below £280 a ton—a figure regarded by some very knowledgeable observers as a critical one in the matter of encouraging substitution—much less was heard of new moves in this direction. However, just as most users are slow to change from one material to another, so are they slow to change back again unless the price advantage becomes considerable. In consequence, copper has probably more or less lost some of its outlets at the moment.

The very high prices which have prevailed for the metal in recent years have naturally encouraged exploration for and development of new deposits, and the expansion of existing ones, and the current world trend of production is fairly sharply upwards, with the result that 1957 looks as if it may see an easier copper supply position than has prevailed for some time.

One of the factors which helped to create such a shortage of metal in the early months of the year was heavy buying by American consumers against the possibility of a serious strike at the mines and smelters during the summer wage negotiations; in 1955 many users had been badly caught by such a strike. In the event, the wage discussions were settled without a strike and at the same time the motor car industry in America and in this country suffered quite a serious setback which had a considerable effect on the copper market.

Whilst at the end of the year American motor car demand was picking up again, the position here had deteriorated further, partly owing to the credit squeeze and partly owing to the adverse effects of the severe oil shortage which followed the blocking of the Suez Canal. This also had some effect on motor car production in Europe. Indeed, had it not been for the consistently high level of demand for copper by the electrical industry, notably in the form of wire, these events might have had an even more powerful effect on the copper market. In Britain, wire makers operated at a very high level, helped by big export orders, particularly from Russia, and in the first eleven months of the year shipments of wire rose to the striking total of 49,763 tons compared with 25,786 tons in the corresponding period of 1955, and only 4,416 tons in January/November, 1954. Whether such a high level of overseas demand can be expected in 1957 is doubtful.

In the spring of 1956 a Government White Paper stated that some holdings from the strategic stockpile would be disposed of, and later in the year it was announced that in the case of copper 36,000 tons would be involved. Actual release of the material did not begin until November, and is being spread over five months. This came on to the market when the supply situation had already eased considerably.

Throughout 1956 the Rhodesian Selection Trust continued its policy of attempting to stabilise copper prices by making infrequent changes in the selling figure, which at times was very much below open market quotations. Although the consumers benefiting from this were assisted in securing orders, particularly in the export trade, the dual pricing system has many disadvantages, and at the end of the year negotiations were in progress between the two big Rhodesian producing groups and their United Kingdom consumers with a view to finding some mutually acceptable method.

One other important event in 1956 was the coming into operation of the Restrictive Trade Practices Act, as a result of which price fixing by copper and brass trade associations has largely ended, although it looks as if a system of price leadership in the various products may result in a persistence of considerable uniformity in quotations.

TIN.—In the early part of 1956 there was a marked stringency in tin supplies, and in late February up to £900 was paid for cash tin, with the backwardation between spot and forward reaching the extremely large figure of £65 a ton.

In April it was announced that the Government-owned Texas City smelter in America would continue in operation until the end of January, 1957, but although this meant that appreciable tonnages of Bolivian, Siamese and Indonesian ore were taken off the market and the resultant tin was stockpiled, the trend of prices was easier, helped by the slowing down in the motor car industry on both sides of the Atlantic.

By early July quotations had fallen to about £730 per ton, but with the International Tin Agreement officially coming into operation from the beginning of July, confidence was restored and prices ruled at higher levels in the remaining months of the year, and temporarily rose well above £800 a ton when shipments from the East

were threatened and delayed by the Suez Canal crisis.

After allowing for the amount of tin stockpiled by the American Government, a close balance was achieved between supply and demand over the whole of 1956, and while in the early part of 1957, with the closing of the Texas City smelter, a small surplus of production seems probable by the end of the year, consumption is expected to improve sufficiently to overtake output, which shows little sign of expanding materially, and in Bolivia and Indonesia has tended to recede in the last year or two.

The buffer stock set up under the International Agreement is now receiving substantial cash contributions from producers, as under the terms of the agreement it is more advantageous for them to pay in cash than to contribute physical tin. The cash contributions are made on the basis of £640 a ton, whereas metal is fetching much higher prices in the open market. There is a considerable likelihood that the price limits set in the agreement may be raised during 1957, but at present the buffer stock manager may buy tin from £720 down to £640, below which he *must* buy it; from £720 to £800 the buffer stock does not operate on the open market; from £800 upwards it may sell tin; and above £800 must sell tin, in an endeavour to achieve reasonable stability in prices. At present, however, whilst the buffer stock is constituted to support the market if necessary, it can do nothing to hold upward movements in check as it has no physical tin to offer.

LEAD.—All the strings in the lead market have really been held throughout the year by the U.S. Government. The programme of stockpiling domestic mine output of lead and zinc, introduced in the summer of 1954, has provided the American market, and thereby the world market, with a floor level; inside the United States this has been 16 cents a lb, to which level the U.S. producers raised their price in January last year. At the time, there were one or two doubts whether the U.S. Government would exhibit continued interest at this level, but it did. On the London market, the equivalent effective level, after U.S. duty, freight, etc., are taken into consideration, is round about £110 per ton.

In the latter part of the year, a new development has been barter deals by the U.S. Government, exchanging surplus agricultural produce for foreign lead and zinc. It is believed that some 50,000 tons has gone to the United States in this way in recent months. As the year drew to a close, the market received another boost when it was announced from America that the Government had decided to continue the domestic stockpiling programme "until a new programme is evolved." In addition, it was intimated that the policy of acquiring foreign material by barter was to be continued. Although it was not known exactly how much lead had been delivered to the stockpile each month by the American producers, it was widely believed that the target tonnage initially set had been almost reached at the end of 1956, and, before the U.S. Government announcement, a certain amount of anxiety was beginning to be felt, especially in American producing circles.

It is rather ironical that lead should have benefited to this extent from the attentions of the U.S. Government, as, of the four metals—copper, tin, lead and zinc—lead was inherently the strongest in 1956 anyway. To a large measure, this may be attributed to the way in which consumption has held up—a phenomenon to which the activity of the cable industry throughout the year has contributed not a little. Another important outlet for lead—also electrical—is in motor car batteries. Whilst this outlet was, naturally, not in its best form in 1956, because of the adverse fortunes of the motor car industry, it must be borne in mind that the relationship between new car output and battery sales is not a strict one, owing to the steady demand for replacement units.

With further American support assured, at any rate for early 1957, but with consumption currently showing, if anything, slightly less strength, the outlook is for a fair measure of stability.

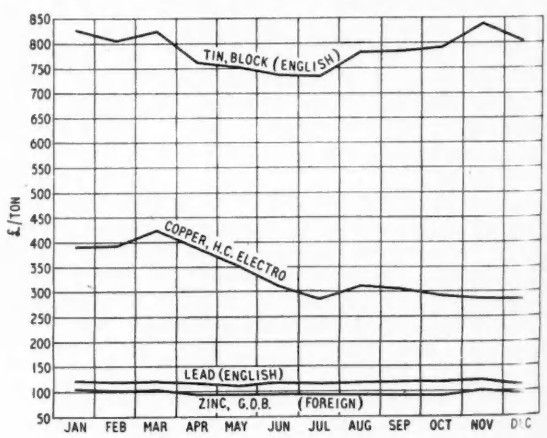
ZINC.—Like lead, zinc also benefited in 1956 from support in two directions from the American Government. In contrast, however, zinc felt the need for some such artificial support practically throughout the year. Of recent years, an increasing proportion of zinc has been taken up for diecastings, and whilst items produced in this manner find their way into an immense variety of end-uses, the biggest individual outlet is the motor car industry. The dependence of zinc on the motor car industry, therefore, is pretty direct, and much greater than zinc interests like to see.

In view, therefore, of the decline in activity in the motor industries of most countries of the world, it is obvious that the support afforded by U.S. Government action must have been reasonably generous. Not only was the programme of stockpiling more or less whatever domestic production the American mining companies liked to offer continued, but overseas deals in surplus agricultural products were also pursued to such effect that at the time of writing over 100,000 tons of metal has been absorbed. The possible impact of such a tonnage on the market, even over a period, makes an interesting study.

Zinc, like lead, was subject for a short period to one additional outside influence; this was a strike of dock workers in Australia. After being threatened for some time, this broke in late January and was continued for three weeks, but the effect on the price of both metals was not so severe as was at first feared. This was particularly so in the case of zinc, where the product affected is not metal but concentrates, providing more scope for levelling out the effects of such a stoppage. A similar anxiety was aroused by the final blockage of the Suez Canal, but it was soon appreciated that the effect would be even less serious than had been the dock strike, as the journey round the Cape takes only two days longer.

With the same U.S. Governmental intervention in store as was experienced in 1956, the zinc market is not likely to show any great alteration in 1957.

ALUMINIUM.—In market terms, 1956 was not such a good year for aluminium as 1955. For many consumers it was the most unstable year for prices since the war, partly because high prices had to be paid for aluminium from unconventional sources in the opening months.



Most Soviet satellite countries contributed a little metal, as did Russia herself, and Japan. Additional supplies were also received from America, by special arrangement, in the early months of the year, when the world shortage in primary metal was at its acutest. We discussed last year the weather considerations which led up to the decline in production, although, of course, healthy consumption also played a part.

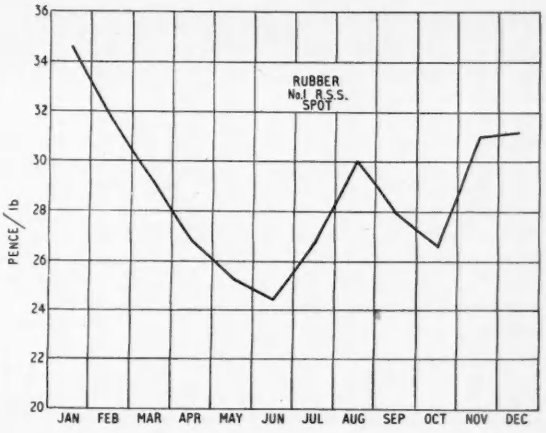
By April, however, the premium on such additional supplies had shrunk from a peak of £60 per ton to almost nothing, following the thaw in Canada and other Northern Hemisphere producing countries, and the improved availability of the metal. Already at this stage of the year, however, credit squeeze factors were beginning to have an effect on the level of aluminium consumption, as well as of other non-ferrous metals, not only in the United Kingdom, but in other European countries. Already, too, mutterings were beginning to be heard that the American motor car industry was not starting the year as well as had been the case in 1955. Whilst, over there, the depressing period for this industry which was to follow did not have much direct effect on aluminium, the information is important in providing a pointer to the position of most consumer goods industries in the United States—especially household consumer goods.

In Europe, the position of the motor industry, on the whole, was scarcely better, especially in the United Kingdom, and on this side of the Atlantic the significance for aluminium is more immediate, particularly where secondary metal ingots are concerned. Throughout Europe, the blocking of the Suez Canal, and consequent petrol rationing, have aggravated the situation.

As aluminium is not an open market, except for marginal quantities, the adverse market conditions have not been reflected in prices—rather the reverse. The United Kingdom price was advanced three times in 1956—on 1st January to £179, 31st March to £189, and 14th August to £197, while over the latter part of the year a surcharge of 30s per ton was levied to meet, retrospectively, the additional cost of securing the American material referred to in the first paragraph. This year, increases in semis prices (with the exception of one caused by a rise in engineering wages) have been rendered inevitable by increases in raw material costs, although it is obvious that some fabricators have cut their margins somewhat drastically.

The basic optimism of the industry, however, has never deserted it, and the still enormous expansion in possible outlets continues to beckon to greater production. The African continent, particularly, has been the scene of the inception of some ambitious plans, and the realisation of others slightly less ambitious. North America has again provided its quota of new capacity installed and announced, whilst other developments are taking place in South America, Europe and Asia.

RUBBER.—During last year prices of raw rubber moved over a fair range, but they were rather more stable than in 1955, avoiding the high price peaks seen in that year. After opening the year at between 2s 9d and 2s 10d per lb, quotations sagged to around 2s in May and June, but in the latter months of the year climbed again to about 2s 8d, thus recovering most of the ground lost. The recovery in the second half of the year was due primarily to the trouble in the Middle East, finally resulting in the closing of the Suez Canal through which, of course, large quantities of rubber from Malaya and Indonesia are normally shipped. Had it not been for this fact, the market might well have had an easier tone, as consumption of natural rubber was adversely affected, particularly in



the second half of the year, by the recession in the motor car industry in America and Britiain, leading to a falling off in the demand for tyres.

United Kingdom stocks were maintained at a reasonable level, rising from about 36,500 tons at the beginning of the year to around 47,000 tons in April and subsequently declining again to about 40,000 tons. Similarly, in America stocks of natural rubber, which stood at about 111,000 tons at the beginning of the year, declined to the region of 90,000 tons. Stocks of synthetic rubber in America, however, have risen, as with the production plants taken over by private enterprise, output has increased but the larger quantities have not always been easy to sell in full.

Both in America and in this country consumption in 1956 of natural rubber will almost certainly have been lower compared with 1955, and world production is estimated to have been about 1,835,000 tons, compared with 1,912,500 tons in 1955.

IRON AND STEEL.—The British iron and steel industry has had a trying and in some ways disappointing year. It fully expected to be able to produce 21 million tons of ingots—or even 21·3 million tons—against 19·79 million in 1955, but two factors prevented this. First, there was the overtime ban imposed by maintenance men in the industry, which began on a small scale in April and gradually assumed rather more serious proportions as strikes broke out when the managements used staff to maintain equipment. Although not all works were affected, a serious loss of output resulted, and when the trouble was finally settled in August something like 400,000 tons of ingot production had been lost.

By then the summer holidays were in full swing and no attempt could be made to make up the loss until the autumn. When the autumn came, however, steel production seemed to lag, and a new peak level was only just reached in November. As a result, raw steel production last year is not expected to have been more than 20·6 million tons.

The slow pick-up in production after the summer holidays seemed to be due to a fall in the demand for steel from the motor car industry; sheet makers just did not drive their mills to the utmost. The demand for sheet steel during the year has, in fact, fallen drastically, mainly as a result of the motor car trade recession but partly because of reduced activity in other consumer trades following the credit squeeze.

It was the heavy steel trade which was overwhelmed with orders last year, the demand for sections for building and for plates for shipyards, boiler-makers, etc., having

been enormous. While imports of sheets have sunk to a relative trickle—6,400 tons in October, against 40,000 tons during several months of 1955—imports of heavy sections and plates have been rising rapidly. In the first ten months of 1956 imports of heavy plates totalled 167,000 tons against 31,000 tons in the same period of 1955, and those of sections 198,000 tons compared with 73,000 tons. Even so, shortages of material have occurred, and the shipyards, especially, have voiced many complaints.

The Government has aided imports of steel by extending the suspension of import duty on a wide range of products, and apart from galvanised sheets and (after 18th March, 1957) tinplate, most rolled steel products will be free of duty until 18th September, 1957. Distribution control of tinplate has also been discontinued, as with new plant coming into service production has risen considerably and the country's full needs can now be comfortably met from domestic sources.

Towards the end of the year the steel industry was confronted by a fresh set of problems arising from the cut in supplies of oil. Fuel oil—used for about one-third of ingot production—was cut by 10 per cent, and there was a similar cut in supplies of gas diesel oil used in many works internal transport locomotives. The fuel oil cut has been offset by greater use of creosote pitch, and ingot loss has been negligible. Any further reduction in the availability of fuel oil, however, would be very serious. An additional cut of 10 per cent in gas diesel oil is taking place, and this will indirectly affect iron and steel production.

In order to expand pig iron production, several new furnaces have been built and two have recently come into operation. Imports of pig iron were heavy during 1956 and will be at a fairly high rate during 1957 as the industry has already contracted for several hundred thousand tons. Stocks have now become very comfortable, so the industry will be able to use the maximum ratio of pig iron in the furnaces and save on high cost imported scrap.

The total deliveries of finished steel to consumers were stepped up considerably last year, partly by increasing output and partly by restricting exports to a level roughly the same as in 1955.

During 1956 costs of steel production went up severely. Coal increased in price, as did foreign ore and the cost of freights; there were wage awards and higher inland transport charges. By increased efficiency the steel industry has been able to neutralise these higher costs to some extent, but not entirely. In addition there has been the need to provide adequate capital for investment in new plant—including a badly needed plate mill. As a result there have been two rounds of price increases on the domestic market—one in May when prices went up on an average of 5 per cent and one in December when there was a 6 per cent increase.

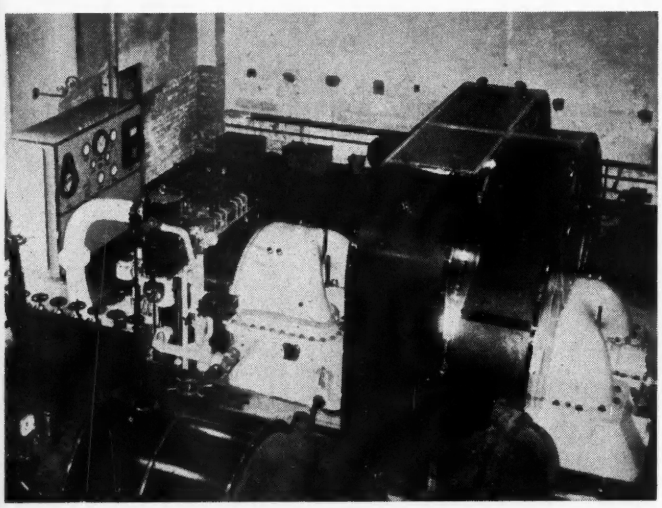
The outlook is none too clear. Activity in the motor car and some other consumer industries has slackened off, and some fall in building operations may soon begin to become apparent as a result of the Government's credit squeeze. The shipyards and heavy engineering industries, on the other hand, are heavily engaged and hold sufficient orders to keep them that way for a long time.

There is capacity to produce 22 million ingot tons or more in 1957, but whether that figure will be reached remains to be seen. The two vital factors governing production will be the strength of demand and the oil supply situation.

Turbo-Blower Installation

A £60,000 turbo-blower has been commissioned by the Workington Iron & Steel Co., a branch of the United Steel Companies, Ltd., to enable their three blast furnaces to operate simultaneously at full capacity. It had formerly been the practice to keep only two furnaces in blast, while the third was off for relining and repairs. The new turbo-blower (which replaces a 35-year-old unit now being retained as a standby) is capable of supplying sufficient air to burn 4,620 tons of coke per week, representing an iron output of 5,000 to 5,500 tons. It was designed and made by the British Thomson-Houston Co., Ltd.

B.T.H. 62,000 cu ft/min turbo-blower installation



The blower is a two-stage single-cylinder machine, with backward-inclined vaned impellers. The diffuser system consists of four partial spirals connected to four straight conical diffusers, which permit the transformation of kinetic energy into pressure energy at high efficiency.

The turbine is a nine-stage machine fitted with nozzle governing gear. The six control valves are hydraulically operated by means of a rotary servo-motor, which is controlled by a balanced pilot valve linked to the governing system. A normal emergency governor is fitted to the turbine, together with a pre-emergency centrifugal governor which limits the maximum speed of the machine.

Air requirements are controlled by Reavell "Askania" regulators which vary the turbine speed as necessary. There are a constant volume regulator and an over-riding pressure regulator, the latter limiting the turbine speed and consequently the blast pressure to any desired setting. An anti-surge regulator, actuating a blow-off valve in the discharge main to atmosphere, enables the blower to operate at volumes below the natural surge limit. As the blower runs at variable speed, the surge volume alters according to the delivery pressure, but the anti-surge regulator can be set to follow pressure changes closely, and thus prevent unnecessary blowing-off.

During recent trials, when delivering 62,000 cu ft/min at 18 lb/sq in (the maximum rating of the machine) the adiabatic efficiency of the blower was 82 per cent.

Indian Industrial Expansion

Four-Fold Increase in Steel Production by 1960

From Our Indian Correspondent

WITH the last of the three steel agreements now signed, the plan for steel industry expansion in India can be said to be really under way. The last agreement was signed in November with the Indian Steelworks Construction Co. (ISCON)—a consortium of 13 British companies—whereby this British combine is to equip and construct for the Government of India an integrated iron and steel works at Durgapur, West Bengal. Particulars of the contract were given in the *Electrical Review* of 9th November (p. 862). The previous two agreements were with Krupps-Demag for a similar steel plant at Rourkela, Orissa, and with the Soviet Government for a plant at Bhilai, Madhya Pradesh. The British contract, worth about £100 million, provides for the completion of the entire works by 31st July, 1961, but the first and second blast furnaces with adequate coke-making capacity and ancillary services will be in operation by 31st October, 1959, and 30th April, 1960, respectively. The Durgapur works will have an output of 1,250,000 tons of ingot steel per year and 360,000 tons of pig iron. Total saleable steel production will be 790,000 tons.

Steel production is probably the most ambitious part of India's five-year plan. Total output last year was just over a million tons (see table) and the target for 1960 is 4·68 million tons. The existing capacity is to be more than doubled, from 1·14 million to 2·4 million tons, and three additional plants are to be set up with an aggregate capacity of about 2·3 million tons. The capital investment in the three steelworks themselves will be approximately £270 million. Besides, there will be capital expenditure for new iron ore mines, limestone quarries, etc., the cost of the townships and ancillary services. The works are situated within the area of the new hydro-electric grid fed by the Damodar Valley, Hirakud and Machkund hydro stations.

Although the programme is now fully under way, doubts are still being expressed about the adequacy of transport to carry over 25 million tons of raw materials over long distances, and about the general standard and availability of technical and operational staff necessary for the operation and maintenance of the works when commissioned. Transport will probably be the biggest bottleneck and might, according to many economists and financial experts including Mr. Eugene Black of the World Bank for Reconstruction, jeopardise the success of such large ventures as steelworks, which involve the movement of considerable quantities of materials. The works may be ready by 1960, and some will possibly be ready by 1958 or thereabouts; but it will be a long time before they are handed over to the Government as going concerns.

EXPANSION OF INDIAN STEEL CAPACITY IN THE SECOND FIVE-YEAR PLAN

	Existing capacity (in million tons of finished steel)	Target for 1960 (in million tons of finished steel)
Expansion of existing works—		
Tata Iron and Steel Co.	0·78	1·50
Indian Iron and Steel Co.	0·33	0·80
Mysore Iron and Steel Co. ..	0·03	0·10
Establishment of new works—		
Rourkela Plant (Krupps-Demag) ..	—	0·72
Bhilai Plant (Soviet Russia) ..	—	0·77
Durgapur Plant (British)	—	0·79
Total	1·14	4·68

Oil Supplies

Upon his return from a tour of Canada and the United States Mr. K. D. Malaviya, Minister for Natural Resources and Scientific Research, told the Indian Parliament that annual oil production in India was expected to rise to seven million tons by the end of the Second Five-Year Plan, i.e. by 1961. At present, India produces only about 400,000 tons from its Assam oilfields, against a consumption of over four million tons. Mr. Malaviya's expectations are based on the recent drillings in Upper Assam where oil has been struck at Nahorkotiya at a depth of about 10,000ft. The Minister said that the Government proposed to spend Rs.30 crores (£22·5 million) on oil exploration during the next five years. For this purpose and for formulating an integrated oil policy for the country, a high-powered directorate for oil and gas has been set up with its headquarters at Dehra Dun, near Delhi.

India's only oilfield is at Digboi, Assam, which produces about 65 to 75 million gallons per year. This output is refined at the Digboi refinery which handles roughly 4,500 to 5,000 barrels of crude oil per day. In addition to this British-owned refinery, there are two more refineries, both at Trombay, near Bombay, on the west coast, one of two million tons annual capacity owned by Burmah-Shell, and the other of 1½ million tons capacity under Standard-Vacuum control and management. The crude oil for these refineries comes from outside. A third refinery, of one million ton capacity, is being put up by Caltex at Visakhapatnam on the east coast halfway between Calcutta and Madras, serving the important hinterland of Orissa and Madhya Pradesh. The recent strike by the Assam Oil Co. at Nahorkotiya in Upper Assam will call for another refinery, either near the oilfield or at Calcutta; Calcutta seems the likelier site. The Nahorkotiya reserves are estimated to be sufficient for a production target of 2·5 million tons of oil per year, in addition to 45 million cu ft of gas per day, equivalent to about 0·6 million tons of fuel oil per annum.

The oil exploration programme falls broadly into two categories: Government-sponsored with the technical aid of foreign consultants; and privately financed by the well-known international combines. The official programme envisages an annual outlay of Rs.6 crores (£4·5 million) and is already under way with the assistance of experts drawn from Soviet Russia, Canada, Roumania, the United States and France. The programme is concentrated in the Punjab, Kutch and Gujerat—the western states bordering Pakistan. A team of about forty Soviet technicians is at present visiting India to undertake a geophysical survey in the oil-bearing areas of Jwalamukhi, Nurpur, Janapuri and Dharamsala in the Punjab. In

addition, a crew of 44 Russian experts will operate the two drilling rigs that have been purchased by the Government from the Soviet Union at a cost of Rs.74 lakhs (£550,000). Both these rigs will be situated in the Punjab. A French party is arriving in India very shortly to negotiate with the Government the terms of their participation—probably in structural drilling in Cambay.

The non-Governmental activity is confined to Bengal where Standard Vacuum hope to start drilling operations early next year. They hold an extensive prospecting concession in the Assam-Bengal region but their spokesman said recently that more detailed and extensive investigations were necessary before drilling on a large scale could begin. The Assam Oil Co. is also engaged in exploratory operations in Hugrijan and Muran, near their Digboi refinery. The proposed Calcutta refinery will probably be a joint Assam Oil-India Government affair, but the question of price of refined oil is, it is understood, the cause of much dispute.

NEW BOOKS

The Economics of Electrical Installation Design. By George A. Wedge, A.M.I.E.E., F.I.E.S. Pp. 312; figs. 119. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 45s.

I readily responded to the invitation to review this newly published book because I found the title exciting. Here was something needed, and here, surely, was something imaginative and useful.

In the preface the author says one of the objects of this book is " to provide sufficient data to enable the designer to decide the most economic type of installation to fulfil any given purpose," and he makes clear the difference in his mind between the words " economic " and " economical." If the following 300 pages of this book had been confined to comparisons of methods, based both on cost and performance, the book would, in my view, have been the more valuable. As it is, the author has allowed himself to be side-tracked into dealing with the methods themselves—surely he would have been wiser had he assumed that these were within the knowledge and competence of his readers ?

In reading the book, I find the arranging of chapter subjects to be rather untidy, and not in a sequence one might reasonably expect from the title itself. From the contents I find that Chapter V is devoted to " Tariffs, Maximum Demand and Diversity "; Chapter VI to " Lighting "; Chapter VII to " Motors and Motor Circuits "; Chapter VIII to " Distribution "; Chapter IX to " Heating "; and Chapter X to " Substations." I think it was G. K. Chesterton who recalls for us " the night we went to Bannockburn by way of Brighton Pier "; I fear that Mr. Wedge has travelled on the same road.

I was delighted to see him commit to print some of the problems of co-ordination in the preliminary planning of a building enterprise—the client, the architect, the builder and the many other specialist services, which to-day have to form an integral part of any modern commercial or industrial building. The reconciliation of these varying points of view would be of tremendous value, not only to the electrical installation industry, but to the building industry as a whole.

I think it is a pity that Mr. Wedge, on page 87, schedules an imaginary load and arrives at the rather astonishing figure of 414·559 kW, and then calculates the size of the main isolators as having to carry 613·91 amps per phase. Surely economics demand that Mr. Wedge should stop calculating as soon as he gets to the decimal point—it really is a waste of time. There is so much in this book that could be good and useful, but I found myself keenly disappointed that he did not seem to get a real grip on so many important matters and present them either forcefully or conclusively.

In his section devoted to " Economics of Various Types of Lamps," he omits to include in his calculations the relative costs of wiring. Clearly, capital and amortisation costs for 50 kW of tungsten lighting are vastly different from those for 25 kW of fluorescent lighting, and yet the result in terms of lighting intensity would roughly be the same. His comparison of lighting running costs (page 170) gives an example of a lighting installation operating 425 hours per annum, that is, eight hours a week, with current supplied at a flat rate of ½d/kWh, with apparently no kW charge of any kind. In my experience, examples of this kind are so untypical as to make comparisons rather valueless.

There is undoubtedly a lot of useful information in this book, and I was very much hoping that it might be one I could buy and give to my engineering staff as a Christmas present, but for this I must wait for Mr. Wedge's next publication.—J.M.H.

Analysis of Bistable Multivibrator Operation. By P. A. Neeteson. Pp. 82; figs. Philips Technical Library, Cleaver Hume Press, Ltd., 31, Wright's Lane, Kensington, London, W.8. Price 15s.

This short book, of about 80 pages, is devoted entirely to the Eccles-Jordan flip-flop circuit. Such circuits are very extensively used in electronic counters and computers as well as in many radar systems. The author feels that no really thorough analysis of the device has ever been presented so he has published the contents of a doctoral thesis presented to the Technical University of Delft.

Starting from the well-known equations for the static condition the author analyses the behaviour of the circuit in responding to step-function trigger pulses. The first transient condition results from a pulse which cuts off the tube which was conducting and lasts while both tubes are non-conducting. The second stage starts when the tube which was initially non-conducting comes on and the final stage starts when this tube starts to draw grid current. The elaborate algebra, required to reduce the equations to a useful form, is given in great detail. Comparisons between the theoretical curves and oscilloscope measurements on circuits are given, which indicate that the theory agrees well with the measurements. However, the analytical technique used presupposes that the transients due to each step function die out before the next step is applied and this precludes the author from giving a treatment fully valid for the upper limit of the operating frequency.

The general design of flip-flop circuits is discussed, but it is not made very clear whether this elaborate analysis has really contributed any useful new information not contained in much simpler accounts.

As a thesis this seems a most praiseworthy effort, but one must be allowed to wonder whether it really justifies publication in book form.—A.H.W.B.

ELECTRICAL WHO'S WHO

The 1956–57 edition of the " Electrical Who's Who " contains some 7,000 entries in addition to an index in which names are classified under companies or other organisations. It is available from Iliffe & Sons, Ltd., Dorset House, Stamford Street, S.E.1 ; the price remains at 21s (postage 1s 5d)

Argentine Power Problem

From a Correspondent

THE growing seriousness of Argentina's power problem was emphasised by the supply companies in October. One of the two serving Greater Buenos Aires has issued a warning that its installations have reached the limit of productive capacity and from now on it will be increasingly difficult, and soon impossible, to meet new demands for services with the existing equipment. Obstacles were placed in the company's way some years ago, when it was comparatively easy to raise capital and import materials. To-day, it is financially impossible to do so with electricity tariffs at present levels. Whereas fuel and labour charges have risen tenfold since 1939, electricity tariffs have only been increased 3·5 times.

The Asociacion de Productores y Distribuidores de Electricidad, representing companies responsible for 80 per cent of the national output, estimates that installed capacity should be raised to 2,000 MW. In a memorandum to the Minister of Commerce the companies insist that the additional capital required cannot be obtained from private sources until confidence is restored in the stability of such investments and in the prospects of a fair return. The electricity output grew by 7·1 per cent between 1921 and 1941, then slowed down to 5 per cent owing to difficulties and restrictions imposed on the companies, whereas the demand is doubling every ten years. There is no reserve capacity to permit periodical overhauls and any mishap results in temporary cuts and deficiencies in the services. Tariffs have failed to keep pace with production costs and new investments have been discouraged by arbitrary measures, such as the expropriation of 61 power-houses in the 1944-55 period.

In conclusion, the signatories ask the Government to take steps to arrest the steady decapitalisation of the concerns and create the conditions necessary to enable them to contribute to the country's economic development.

Dr. Prebisch's "Recovery Plan" estimated the immediate needs of Greater Buenos Aires at 1,150 MW against an installed capacity of only 840 MW, and those of the interior at 900 MW, an increase of 50 per cent over existing capacity. Combining two of Dr. Prebisch's proposals, the Government announces that it proposes to build and finance a State-owned power plant of 600 MW in the South Dock, at a probable cost of 2,000 million pesos. The work will be carried out in stages, each providing 100 to 150 MW, and the station must be completed within two to three years of the date of signing the contract.

More immediate, but partial, relief will be afforded when completion of the transmission lines from the San Nicolas power station provides Buenos Aires with an additional 190 to 200 MW, probably in 1957.

La Prensa reported recently that two Swiss financial corporations are prepared to invest capital in the Latin American electrical industry, provided they are assured of a liberal economic policy. The corporations in question refer particularly to Argentina.

A committee was recently formed in Concordia to revive the 1946 project for harnessing the Salto Grande Falls on the River Uruguay and building a power station. The scheme, which interests Argentina and Uruguay, is estimated to cost 1,000 million Uruguayan pesos and would be shared by the two countries. In addition to building a power station, the project provides for regulating the flow of the river, improving navigation and permitting irrigation of large tracts of land on both banks.

Although Argentine official circles announce that conversations are well advanced with the Uruguayan authorities for carrying out the scheme, expert opinion in Argentina is not unanimously favourable. It has been argued that the site for the station is 270 miles from Buenos Aires by the direct route, which crosses the difficult marshy lands of the Parana Delta. Further, the areas bordering on the River Uruguay enjoy one of the highest rainfalls of the country and do not require irrigating, while navigation over the upper reaches of the river is of relatively little importance to Argentina.

According to a statement by Dr. Blanco, of the Argentine Treasury, the Export-Import Bank's $100 million credit will be used entirely for the purchase of transport equipment. Power plants and other electrical installations and industrial machinery are also urgently needed, but rank lower in the list of priority requirements. The problem of electric power is now under study at the Ministry of Industry and Commerce, he says, and will form the subject of later negotiations.

Comparing the first six months of 1955 and 1956, the value of Argentine imports of British electrical equipment increased by £15,470 to £138,226. The introduction as from 2nd July of flexible multilateral trading with ten of the principal European countries marks the end of the old restrictive system of bilateral agreements, which proved so disastrous to British exporters.

Locating the Wash Causeway

PARTICULARS are given in *Eversheds News* of the earth-resistivity method applied in an attempt to locate the mediæval causeway believed to exist across the estuary of the old Wellstream (now some way inland), where King John's baggage train is believed to have been lost in 1216. The procedure adopted by Eversheds and Vignoles, Ltd., acting on behalf of the Wash Research Committee, is based on the assumption that the path taken was made up of harder and more firmly packed soil than the adjacent quicksands and that a hard bed of clay (into which articles would not sink) is known to lie about 40ft below the ground surface. Four electrodes were driven into the ground at various intervals in a straight line and a current passed between the two outer electrodes. The ratio of the potential difference between the two inner ones to this current gives a resistance value, R, and the resistivity of the soil, ρ, $= 2\pi aR$, where "a" represents the electrode separation.

Earlier experiments with a model in which a sheet of aluminium represented the path revealed that when the traverse line of electrodes passed over a rise in the surface of the aluminium sheet the soil-conductance curve showed a double hump. As the electrode system approached the rise the conductance increased and then fell as the electrodes passed over the top, increasing again and finally decreasing as the electrodes got well clear; this hump effect was probably caused by a constriction in the current path at this point.

In the preliminary investigation in the Wash area, which lasted four weeks, 124 traverses were run, involving about 1,000 readings of the Series 1 "Megger" earth tester employed. Analysis of the readings by Dr. G. F. Tagg, chief research engineer of Evershed & Vignoles, Ltd., appear to have confirmed the existence of the causeway. The next steps are under consideration by the Wash Research Committee.

GENERATION AND DEVELOPMENT

Boards' Sales in November

Amplifying the electricity output figures for November published in last week's issue, the accompanying table analyses the sales of the twelve Boards in England and Wales. The national figures show an increase over November, 1955, of 8·7 per cent, but when corrected for weather conditions and working days, the increase is 7 per cent.

ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for November (million kWh)			Twelve Months Totals Ended 30th November (million kWh)		
	1955	1956	Inc. or Dec. %	1955	1956	Inc. or Dec. %
London	638·8	706·2	+10·6	6,473·4	7,049·3	+ 8·9
South Eastern	384·1	435·0	+13·3	3,957·6	4,447·8	+13·2
Southern	466·5	536·6	+15·1	4,773·3	5,407·9	+13·3
South Western	237·5	252·6	+ 6·4	2,458·9	2,752·0	+11·9
Eastern	613·0	695·8	+13·5	6,364·7	7,119·2	+11·9
East Midlands*	532·6	579·0	+ 8·7	5,562·7	6,056·4	+ 8·9
Midlands*	708·1	744·4	+ 5·1	7,345·0	7,798·2	+ 6·2
South Wales*	396·0	410·1	+ 3·6	4,269·9	4,510·8	+ 5·6
Merseyside and N. Wales*	412·2	440·5	+ 6·9	4,371·4	4,765·8	+ 9·0
Yorkshire*	690·7	743·2	+ 7·6	7,226·8	7,850·2	+ 8·6
North Eastern*	391·2	431·8	+10·4	4,169·7	4,515·4	+ 8·3
North Western*	737·6	771·7	+ 4·6	7,780·7	8,270·6	+ 6·3
Total all Area Boards	6,208·3	6,746·9	+ 8·7	64,754·1	70,543·6	+ 8·9
Direct Supplies by Central Authority	171·1	187·5	+ 9·6	1,848·8	2,149·4	+16·3
Grand Total	6,379·4	6,934·4	+ 8·7	66,602·9	72,693·0	+ 9·1
Mainly Industrial Areas*	3,868·4	4,120·7	+ 6·5	40,726·2	43,767·4	+ 7·5
Mainly Non-Industrial Areas	2,339·9	2,626·2	+12·2	24,027·9	26,776·2	+11·4

* Those in which industrial consumers took over 50 per cent of the total sales in the preceding financial year.

Modified Scheme for Langdale Supply

It has been announced that the Minister of Fuel and Power has approved compromise proposals for supplying electricity to the Langdale area of the Cumberland Lake District. An inquiry into the scheme was held in August, when it was stated that the proposals of the planning authorities for more underground cables to be used would add £25,000 to the cost of the work. The Ministry has approved the erection of overhead lines in certain areas, and the laying of underground cables in others.

Grid Line Inquiry

A public inquiry was opened at Dorchester on 20th December into a proposal by the Central Electricity Authority to erect a 132 kV transmission line from Poole to Yeovil. The principal objector was Sir Francis Hopwood, who owns a fourteenth century manor house, Bingham's Melcombe, and some 800 acres of the valley in which the manor stands. Earlier the C.E.A. had agreed to an alternative route avoiding the valley, but subsequently the Dorset planning authority rescinded its approval of the diversion and recommended a return to the original line through the valley.

At the inquiry Mr. G. A. Jellicoe, past president of the Institute of Landscape Architects and a member of the Royal Fine Art Commission, declared that to put a line of pylons across the valley "would be tantamount to scratching a fork across the face of a painting in the National Gallery of which only one example exists." Sir Albert Richardson, a past president of the Royal Academy, expressed the view that if the pylons were taken around the escarpment to the west it would be the lesser of two evils.

Mr. R. P. E. Watson, representing the C.E.A., said that although the alternative route would cost an additional £1,000 the Authority in no way withdrew from its willingness to run the line in that direction. He submitted that the possible damage to the valley had been greatly exaggerated and that the effect would be relatively small, bearing in mind that the structures would be only 50ft high and well capable of being screened by trees.

When the inquiry was resumed the next day, Sir Hartley Shawcross, Q.C., who appeared for Sir Francis Hopwood, criticised the way in which the Dorset County Council had dealt with the matter, saying that they were obviously content with the diversion round Henning Hill until some hidden influence had made them revert to the valley route. He asked that the County Council should produce all relevant documents, and Mr. J. R. Pryer, for the Council, said he would willingly make the documents available. The inquiry was adjourned until 2nd January.

Nuclear Power Station Inquiry

The proposal by the South of Scotland Electricity Board to build a nuclear generating station at Hunterston, Ayrshire, is to be the subject of a public inquiry, it was announced on 21st December. The inquiry, which it is proposed should open on 29th January, has been ordered by the Secretary of State for Scotland. Various parties have lodged objections with the Secretary of State against the Board's plan to construct the station.

Somerset Site

A Somerset correspondent writes: Hinkley (or Inkley) Point, the site of the proposed C.E.A. nuclear power station, is one of the most solitary and least frequented, and perhaps least inviting, spots in the county and many people who think they know the Somerset coast would have been hard

Inkley Point in Somerset, the proposed site of the C.E.A.'s third nuclear station

put a month ago to say even roughly where it is situated. It is, in fact, almost exactly two miles north of Stogursey and about one mile west of Stolford. The accompanying photograph, taken on a fine Saturday afternoon last August, shows how lonely and deserted it is.

Hornchurch Service Centre

To meet the demands of a rapidly growing district, the Eastern Electricity Board opened a new service centre in Hornchurch on New Year's Day. For the recessed shop front one of the "new woods," known as afrormosia, which is very similar to teak, has been used. The colour scheme in the interior of the showroom, while of contemporary style, has been kept quiet enough to give prominence to the goods and appliances.

Electric floor warming has been installed, the floor being covered with granwood blocks, an inert material which is available in a variety of colours and patterns. The rear part of the shop is designed for demonstrations and screens have been fitted to divide the premises when required.

New Bedford Substation

Work of major importance to the supply of electricity to the centre of Bedford was started by the Eastern Electricity Board recently when three 500 kVA transformers were lowered into the basement of the store of E. P. Rose & Son, Ltd., at the corner of Silver Street and High Street. The transformers will take the place of two housed in a brick building in the Old George yard, which have for some time past been heavily overloaded, and will materially improve the supply of electricity in that part of Bedford. Should development necessitate it, a fourth transformer can be installed later.

The new substation has a special ventilating system which will keep the temperature to 103 deg F with an ambient temperature of 45 deg F. Bakelite insulated copper rod risers are taken from the cable boxes, which are of Henley's latest type, and can be adjusted so that cable entry from any direction can be made.

East Kilbride Reinforcement

A scheme to reinforce supplies to the new town of East Kilbride, Lanarkshire, at a cost of more than £300,000, has been approved by the South of Scotland Electricity Board. New substations will be constructed north of East Kilbride and at Market Hill.

Transfer of Distribution Network

The North Eastern Electricity Board is to take over electricity mains belonging to Dorman, Long & Co., Ltd., and the network will be reinforced to improve supplies to Redcar (N. Yorks.) and Dormanstown. The total cost of reinforcing the Dorman, Long network is estimated at £21,000 and the portion for Redcar £12,500.

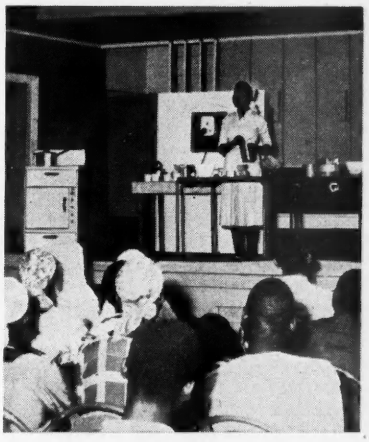
OVERSEAS

Uganda Cookery Demonstration

An electric cookery demonstration was given by the Uganda Electricity Board at the Naguru Community Centre, Kampala, on 18th December principally for the tenants of Naguru, Ntinde and Nakawa Estate houses. Mr. W. D. D. Fenton, chairman of the Board, tells us that this was the first demonstration of electrical appliances given by an African to an African audience in Uganda. It was attended by about 150 men and women and was given by the Board's demonstrator, Mrs. S. Mulira, to show how traditional African dishes can be successfully cooked by electricity.

Speaking in Luganda, Mrs. Mulira first explained the advantages of electric cookers and how they work, and then cooked matoke with sauce on a full-sized electric cooker, followed by cakes on a small boiling ring. At the end of the demonstration she made "tea for two in two minutes," using an electric kettle. She also answered questions from the audience, who later sampled the demonstration food. At the end of the demonstration the smaller types of electrical appliances were on show and could be purchased.

The demonstration was a great help to those present who use electricity for lighting and other small uses and who wish to learn more about electric cookery and how much it costs. The Board intends to give other similar demonstrations for principally African communities and the next one is being held this month at Mengo.



Mrs. Mulira, the Uganda Electricity Board's African demonstrator, shows how traditional native dishes can be cooked electrically

Generators for Kiewa

At the State Electricity Commission of Victoria's Kiewa No. 4 station, the first of six power stations to be built on the Kiewa River, four Metropolitan-Vickers vertical waterwheel generators totalling 64,000 kW are now in commission. The station has been excavated from solid rock, being 450ft underground. The generators are rated at 17,100 kVA, 600 r.p.m., 12·1 kV and are driven by direct-coupled Francis type turbines manufactured by Boving & Co., Ltd., the main contractors. The turbines will work under a head of over 600ft, and owing to the relatively high speed and the consequently small diameter of the generator rotors separate flywheels were fitted.

Metropolitan-Vickers has also in hand six similar generators for Kiewa No. 1 station, where they will be driven by Pelton wheels. When these are installed M-V equipment will be responsible for half the total amount of power generated on the Kiewa hydro-electric scheme.

Rotor of 16,000 kW Metropolitan-Vickers vertical waterwheel generator being lowered into position at Kiewa No. 4 power station

Future of Trolley-Buses

At a meeting of Bradford Transport Committee on 17th December a resolution was unanimously passed urging the Government to give Bradford and other local authorities all possible encouragement by a reduction of tax and rates on trolley-buses. A report was submitted to the Committee by the city engineer (Mr. S. G. Wardley) on a proposed trolley-bus depot at the junction of City Road and Sunbridge Road to provide accommodation for about 100 vehicles.

After the meeting Councillor T. Wood, chairman, said there was no doubt that with nuclear development there would be a much larger scope for electric traction.

NEW ELECTRICAL EQUIPMENT

Anti-Static Mouldings

Mouldings in anti-static rubber recently developed by the RELIANCE RUBBER CO., LTD., Cremorne Works, Cleveland Road, Hemel Hempstead, Herts., have a resistance of 10 kΩ/cu cm. They are available as ordinary mechanical components or as precision mouldings made to limits of ±0·002in.

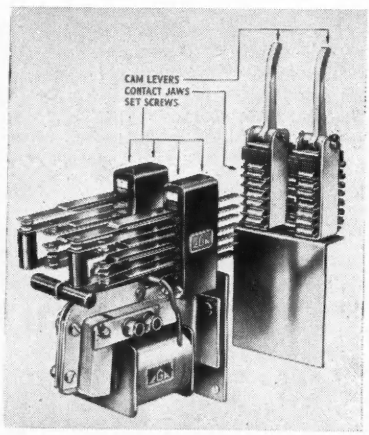
Although anti-static rubber has been available for some time, its application has been largely limited to the manufacture of aircraft tyres and to equipment for hospital operating theatres.

Yet static electricity forms a hazard, or at least possesses a strong nuisance value, in many manufacturing processes—in the textile industry, in paper-making and in printing, to cite just three examples. By virtue of its conductivity, an anti-static rubber mounting for a piece of machinery automatically acts as an earth, as well as possessing anti-vibration qualities. In many other applications it offers the benefits of rubber with the advantage of electrical conductivity.

Plug-in Relays

A series of plug-in relays incorporating many novel features, so that in a matter of seconds a repair can be made or a complete relay replaced, is offered by EGA ELECTRIC, LTD., Holyhead Road, Wednesbury, Staffs. These relays are built on the unit principle, and all parts are easily replaceable, including the contact fingers.

The complete unit consists of a relay, and a terminal base which can be mounted and wired into position before the relay proper is plugged in, there being no soldered connections to the relay itself. The plug-in contacts are compressed in series and locked into position so that there is no likelihood of a faulty or light connection, due to vibration or other causes. In this form, the relay occupies little panel space and makes for neater and quicker wiring and avoids any chance of damage to the relay contacts during wiring.



Ega plug-in relay

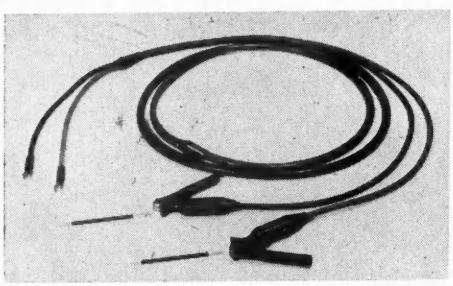
Fused Test Leads

The fused voltage connecting leads fitted to the 7-range clip-on wattmeter made by FERRANTI, LTD., Hollinwood, Lancs., have proved so successful that they are now available as general purpose testing leads.

The leads consist of a 6ft length of 660 V 55/·004in v.r.i., t.r.s. cable fitted with strong crocodile clips having stainless steel jaws and handles made of insulating material. A replaceable h.r.c. fuse is fitted in the handle of each clip and a moulded synthetic rubber sheath covers all but the ends of the clips.

Insulated test prods are provided for inserting in the clips when required. The fuses are English Electric cartridge fuse-links rated at 5 A according to B.S. 1361: Category 250AC3.

Ferranti general purpose test leads



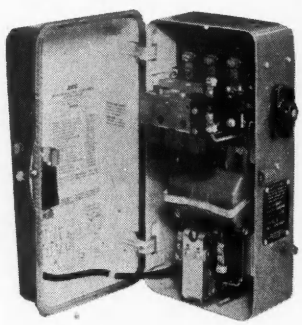
Contactor Starters

A new range of push-button contactor starters has been introduced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. Starters now available are suitable for use on three-phase supplies at ratings up to 7½ h.p. at 600 V. The range is to be extended shortly to cover ratings up to 30 h.p. The starters incorporate a new design of four-pole vertical-lift contactor unit which complies fully with B.S. 775 : 1956. The contactor arc-box is of moulded alkyd and the contacts are silver faced.

Overload protection is provided by a triple-pole magnetic trip unit, which is adjustable for current rating and for "hand" or "self" resetting. For isolation, the starter can be supplied with a double-break cam-operated type of interrupter switch capable of safely breaking the stalled-motor current—not merely the full-load current. An interlock of conventional design is fitted so that the starter cover cannot be removed unless the isolator is in the "off" position. Another safety device is an "off" position lock in the form of an external knurled screw which can be unscrewed to prevent the switch being moved to "on" unless the case is opened for access to the interlock. Thus with a padlock on the case, unauthorised operation is impossible once the screw has been removed.

The whole starter is designed with a view to ease of installation, routine maintenance and inspection. It is housed in a dust-proof sheet steel case finished in dark grey, with a hinged lid on which are mounted the "stop" and "start" push-buttons. In addition to the built-in push-buttons, other forms of control can be accommodated such as remote push-buttons or a pilot switch. Provision is also made for mounting an auxiliary switch on the side of the starter with two pairs of contacts, one normally open and the other normally closed, for controlling auxiliary equipment.

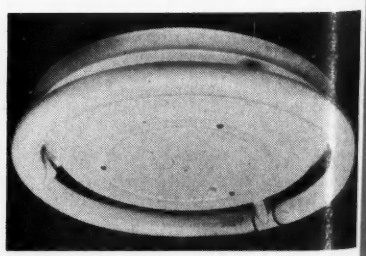
Interior of G.E.C. direct-on-line contactor starter



Lighting Fittings

Additions to their range of tungsten and fluorescent lighting fittings announced by PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2, include industrial bi-pin ceiling channel fittings designed for use with 125 W 8ft fluorescent lamps. There are single-lamp (A6800) and twin (A6801) models. Both are of white stove-enamelled sheet steel and have two 4ft cover plates secured by screws. The channel end caps, which are secured by spring clips, are of white

Philips A6425 industrial circular fluorescent fitting



rigid p.v.c. Lampholders are of the push-on bi-pin type and "Terry" clips support the lamps. The fittings are supplied complete with control gear of the instant start type and include p.f. correction. A radio interference suppressor is fitted and there is provision for conduit or chain suspension and conduit box mounting. The channels may be converted into reflector fittings by the addition of four 4ft white stove-enamelled reflectors (two per side).

An industrial circular fluorescent fitting (A6425) is for use with the 40 W 16in MCF/U lamp. It is complete with switch-start control gear including a p.f. correction capacitor. The main assembly consists of a black stove-enamelled mounting strap and control gear tray with an ivory stove-enamelled cover with safety chain. The mounting strap has provision for direct screw fixing by ceiling, wall or conduit box or, by using a standard conduit accessory, for tube suspension.

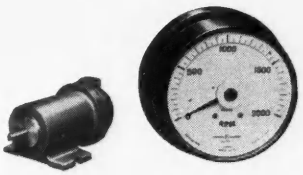
A commercial version (A6430) complete with switch-start apparatus, starter switch and p.f. correction capacitor is also available. The cover is of stove-enamelled ivory with lampholder and lamp supports of moulded ivory plastic. The gear tray is of black stove-enamelled steel. The diffuser, which is of 030 "Perspex" and includes a black/ivory reversible decorative metal disc, is secured to the fitting by a chromium plated, milled-head screw. The ceiling strap is of black stove-enamelled wrought iron, and is drilled for B.S. conduit box mounting/wood screw fixing. For tube suspension, a standard tapped backplate may be used. Spare diffusers are available.

The company's existing "Westcliff" tungsten floodlight has been discontinued and is replaced by the "Westgate Mk. II" weatherproof general dispersive tungsten floodlight for use with 500 W, 1,000 W or 1,500 W lamps. Industrial "Perspex" open-end trough reflectors have been introduced for the "Axminster," "Axbridge," "Aberdeen" and "Auckland" fluorescent fittings and will be available shortly.

Tachometer-Generator Equipment

A new a.c. tachometer-generator equipment comprising a rectifier type moving-coil voltmeter and a miniature three-phase alternator has recently been introduced by CROMPTON PARKINSON, LTD. The tacho-generator driven by the equipment whose speed is to be measured generates a three-phase voltage proportional to the speed. This linear output voltage is applied to the indicator, which can be situated at any reasonable distance away from the equipment under control, without loss of accuracy.

The advantages of the tachometer are that it has no brushes or sliding contacts to cause wear, and as the three-phase voltage impulses overlap each other compared with the single-phase type, the indicator is steady at comparatively low speeds. In addition, it is suitable for control applications.



Crompton tachometer-generator and indicator

Each tacho-generator has a nominal phase voltage of 17·40 V per 1,000 r.p.m. when connected to a circuit having a resistance of 4,600 ohms or 17·81 V per 1,000 r.p.m. when connected to a circuit having a resistance of 13,800 ohms. For speeds below 3,000 r.p.m. where the recommended direct coupling drive cannot be arranged, belt, chain or gear driving may be used, providing care is taken that excessive pressure is not put on the bearing by over-tightening.

The tacho-generator is totally enclosed in an aluminium alloy case, overall height 3¼in, width 4in and length 6in. External magnetic fields are prevented as the stator screens the internal magnet and the entire stator assembly is impregnated to resist damp. At the non-driving end a terminal box is provided, in which small trimming resistances can be fitted, if required, to neutralise the effect of IR drop in the circuit. The combined accuracy of the tachometer-generator equipment is within 1 per cent of full scale deflection, at any part of the scale, while variation in indication with temperature will not exceed 0·125 per cent/deg C.

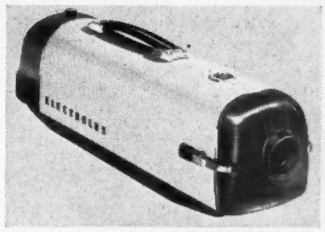
Vacuum Cleaner

The Model 62 cylinder type vacuum cleaner just announced by ELECTROLUX, LTD., 153-155, Regent Street, London, W.1, is fitted with new type runners and nylon rollers enabling it to run easily over carpets of all thicknesses. It has a lightweight tapered hose and the connecting piece has a rotary ball-bearing movement which allows the hose to turn freely. A full set of accessories includes a two-way carpet nozzle with a protective plastic ring, a crevice nozzle in flexible plastic, dusting brush, sprayer, etc.

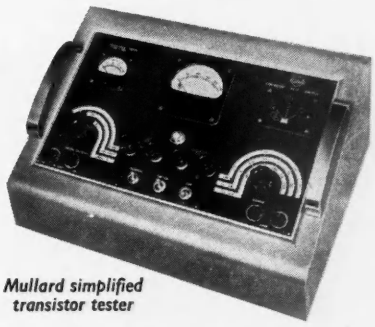
The cleaner is finished in a shade of delicate grey and dark green. The price is £23 plus £10 1s 10d purchase tax in the United Kingdom.

Simplified Transistor Tester

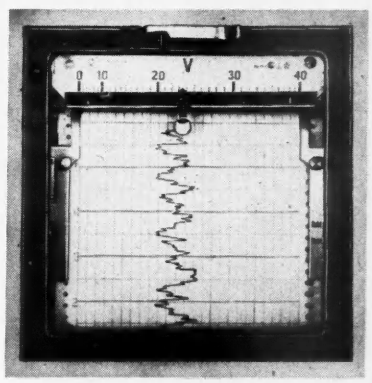
There are many instances where complete and detailed information about the parameters of junction transistors is not needed, but only an indication of their general characteristics and condition. It is to cater specifically for these requirements that MULLARD, LTD., Century House, Shaftesbury Avenue, London, W.C.2, has introduced a simplified transistor tester.



Electrolux Model 62 vacuum cleaner



Mullard simplified transistor tester



"Minireg" recorder

It is compact and as easy to use as a conventional valve tester, and affords a ready means of checking three of the more important junction transistor parameters: base-collector short circuit current gain; d.c. collector current for zero base current; and collector turn-over voltage. All measurements are presented as direct meter readings.

Miniature Recorders

A range of miniature switchboard instruments with the trade name "Minireg" is now available from the STONEBRIDGE ELECTRICAL CO., LTD., 6, Queen Anne's Gate, London, S.W.1. Instruments for voltage, current and watts recording on single-phase and for watts and varmeter records on three-phase three-wire systems are available with a 4¾in chart, giving a 4½ hour visible record with a frontal area of only 5¾in by 5¾in. The chart drive is by synchronous motor or by hand or electrically wound clockwork. Faster chart speeds are available if required. The record trace is either by reservoir pen or inkless system on metallised paper.

Financial Section

STOCKS and SHARES

STOCK EXCHANGE markets entered the new year quietly, but holding firmly to the ground recovered during the course of December. All sections have been helped towards a steadier footing by an impressive hardening of prices in the gilt-edged market. Most of the annual reviews which appear at this time stress the importance of gilt-edged prospects in considering the future of securities of other descriptions: and a majority reach hopeful conclusions in that respect, believing that conditions are more likely than not to call for an eventual easing of the Government's money policy. In the industrial market it seems certain that electrical equipment shares, especially those with strong atomic power connections, will remain among the groups best supported by the investor as the year goes on.

G.E.C.

The last instalment of 20s per share on the 4,285,320 new G.E.C. shares offered to shareholders at 40s in October fell due for payment to-day (Friday). With the disturbing effect of the major operation over, G.E.C.'s have moved up into closer alignment with other leaders in the electrical market. A further rise of 5s, to 50s, is marked in the accompanying tables, which show changes over the last three weeks of the year. On the assumption that the 14 per cent dividend will be paid again on the larger capital which will participate in future distributions, the yield of over 5½ per cent on the shares still compares well with the returns available elsewhere in the groups of companies concerned with the programme of new atomic power station construction.

C. A. Parsons' New Shares

The £1 ordinary shares of C. A. Parsons are now quoted ex-rights to two new issues. One of these is the scrip distribution of one new for every two shares held; the other the "rights" offer of new shares at 30s each on a one-for-one basis. Recent quotations were 52s 6d for the old shares, 53s for those in the second category, and 23s premium for the "rights" shares, on which the subscription money of 30s per share is payable in full by the 16th of this month. These prices represent substantial gains over the past week or two. Issued ordinary capital of the company is now raised from £3·6 to £9 million, the whole of which will rank for the final dividend for 1956, due to be declared in April. No indication has been given of the dividend to be expected. A market publication estimates that the profits earned in 1955 were equivalent to 34 per cent on the present £9 million capital.

A. Reyrolle Issue

Issued capital of A. Reyrolle rises from approximately £3·1 to £4·6

Price Changes in

Company or Board	Nom. Value	Middle price 31st Dec.	Three Weeks' Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	75½	+2	3	3	4 0 6	80½	72½
Brit. Elec. 1974/77	100	73½	+2	3	3	4 2 9	79½	71½
Brit. Elec. 1976/79	100	77½	+2	3½	3½	4 11 6	84	74½
Brit. Elec. 1974/79	100	87½	+2	4¼	4¼	4 18 3	95	85½
Overseas Electric Supply								
Calcutta Elec.	£1	18/6		6†	6†	9 9 9†	20/9	18/6
East African Power	£1	20/-	+1/-	7	7	7 0 0	21/3	19/-
Nigerian Elec.	£1	17/6		10	10*	11 8 6	21/-	17/-
Perak Hydro-Elec.	£1	14/-		10	10*	14 5 6	17/6	14/6
Equipment and Manufacturing								
Aberdare Cables	5/-	10/3	+6d	17½	17½	8 10 9	13/6	9/9
Aerialite	1/-	5/-		45	48	9 12 0	6/9	4/9
Allen, W. H.	£1	35/-		20	10*	5 14 3	39/-	33/6
Aron Elec. Ord.	£1	52/6		15	15	5 14 3	56/-	52/6
Assd. Automation	10/-	17/6	+2/6	10	5	2 17 3	19/-	15/-
Assoc. Elec. Ord.	£1	66/3	−1/3	14	15	4 10 6	85/6	57/6
Automatic Tel. & El.	£1	52/6		15	15	5 14 3	72/6	50/-
Babcock & Wilcox	£1	73/9	−3/9	15	15	4 1 3	85/6	64/-
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/-	3/9
Bakelite	10/-	21/3xd		16	16	7 10 6	34/-	22/6
Berry's Electric	5/-	5/9		—	10‡	8 14 0	6/6	5/9
British Aluminium	£1	68/9	+2/6	12	12	3 9 9	78/9	40/6
B.I. Callender's	£1	50/3	+2/3	10	12½	4 19 6	54/3	45/-
B.I. Callender's 6% Pref.	£1	20/9	−6d	6	6	5 15 9	22/6	20/3
British Tabulating	£1	43/6xd	+2/9	9	9	4 2 9	51/3	37/3
British Thermostat	5/-	25/-		20	25	5 0 0	31/9	24/6
British Vac. Cleaner	5/-	8/-	+3d	30	15*	9 7 6	8/9	6/-
Brook Motors	10/-	30/-		25	25	8 6 9	44/-	30/-
Brush Group	5/-	4/6		10	10	11 2 3	7/9	4/6
Bulgin, A. F.	1/-	4/9	+9d	45	50	—	5/3	4/-
Burco Dean	5/-	9/-	+9d	22½	20	11 2 0	13/6	8/3
Chloride El. Storage "A"	£1	57/6	+1/3	17½	17½	6 1 9	73/6	55/-
Clarke Chapman	£1	127/6	+7/6	20	22½	3 10 6	123/-	89/6
Cole, E. K.	5/-	16/6	+9d	17⅛	17⅛	5 6 0	22/3	15/-
Cossor, A. C.	5/-	6/-	+3d	15	Nil	Nil	10/3	5/-
Crabtree	10/-	23/-		20	20	8 14 0	29/3	23/-
Crompton Parkinson Ord.	5/-	13/9	+9d	16	16	5 16 3	15/-	12/3
De La Rue	5/-	17/-	+6d	30	30	8 16 6	20/3	15/-
Decca "A"	4/-	28/9	+1/9	56¼	43¾*	6 1 9	44/9	23/3
Desoutter	5/-	29/-		25	30	5 3 6	32/9	25/9
Dewhurst	2/-	5/9		30	16¼*	5 13 0	7/6	5/3
Dictograph Tel.	2/-	6/9		20	20	5 18 6	7/3	5/6
Dubilier Condenser	1/-	5/9	+9d	25	30	5 4 3	5/3	3/6
Duport	5/-	17/9xd	+9d	23	25	7 0 9	21/6	13/9
E.M.I.	10/-	24/-	−3d	15	15	6 5 0	37/-	22/6
Electrical Components	5/-	7/-		25	25	8 18 6*	8/-	6/3
Elec. Construction	£1	22/6		8½	8½	7 11 0	29/9	22/6
Elliott Bros.	5/-	26/9	+6d	17½	20‡	3 14 9	36/9	22/6
Enfield Cable Ord.	£1	14/-	+1/-	Nil	Nil	Nil	19/3	13/-
English Electric	£1	48/9	+1/3	12½	12½	5 2 6	66/3	43/9
English Electric 3¾% Pref.	£1	13/-		3¾	3¾	5 15 6	14/6	12/6
Ericsson Tel.	5/-	34/6	+1/6	20†	20†	2 18 0†	42/9	31/-
Ever Ready	5/-	28/3	+6d	35	35	6 4 0	32/9	24/-
Falk Stadelmann	£1	35/9	+3d	17½	17½	9 15 9	45/9	35/6
G.E.C. Ord.	£1	50/-	+5/-	12½	14	5 12 0	65/6	41/3
G.E.C. 6½% Pref.	£1	22/-		6½	6½	5 18 3	23/9	21/3
General Cables	5/-	11/3		30	30	13 6 9	13/9	11/3
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Holdings	5/-	20/3	+6d	25	30	7 8 3	24/6	18/9
Hackbridge & Hewittic	5/-	13/9		30	23*	8 7 9	22/-	13/9
Heatrae	2/-	4/-		15	15	7 10 0	5/1	3/9
Henley's	10/-	15/3	+6d	10½	11½	7 10 9	19/9	14/-
Holophane	5/-	17/6		30	30	8 11 6	21/6	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

million as a result of the "rights" offer of one new share for every two held. These new shares will qualify for the final 1955 distribution, which was declared last time towards the end of March. They have been in strong demand lately at about 22s 3d premium, with the issue price of 70s payable by 16th January. As in the case of the C. A. Parsons issues, no forecast of future dividends on the increased capital has been made. The last total of 16¼ per cent was covered almost seven times over by the earnings of 1955, and the interim for 1956 has been raised by a fraction to 6½ per cent. On the basis that the payment will be maintained at the same rate as before on the larger number of shares now ranking for dividends, the yield on the shares would work out at approximately 3½ per cent.

Electrical Investments

Company or Board	Nom. Value	Middle price 31st Dec.	Three Weeks' Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	24/6	+1/-	70	50	10 4 0	39/3	23/-
I.C.I.	£1	38/3	+9d	10	10	5 4 6	49/9	37/3
Intl. Combustion	5/-	20/-	+2/3	25	20*	5 0 0	25/-	15/3
Johnson & Phillips	£1	28/9	+1/3	15	15	10 8 9	46/6	27/6
Lancashire Dynamo	£1	37/6		15	11*	5 17 0	49/9	37/6
Laurence, Scott	5/-	13/9	−6d	12½	15	5 9 0	16/9	13/3
Lister, R. A.	£1	25/9	+1/3	9·3	10	7 15 3	35/3	24/6
London Elec. Wire	£1	42/6		12½	12½	5 17 9	52/9	42/6
Lucas, J.	£1	30/9	+2/-	7½	7½	4 17 6	40/3	28/9
Marryat & Scott	2/-	8/9		30	30	6 17 3	11/3	8/9
Mather & Platt	£1	51/6	+1/6	15	15	5 16 6	65/3	50/-
Metal Industries	£1	23/-	+6d	9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	45/-		10	12½	5 11 0	48/6	43/6
Morphy-Richards	4/-	12/-	+1/3	50	50	—	13/9	10/-
Murex	£1	67/-	+1/6	20	20	5 19 6	74/6	60/-
Newman Ind.	2/-	2/3		10	10	8 17 9	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	3/-	2/3
Parnall (Yate)	5/-	5/9	−3d	14	12	10 8 9	9/6	5/6
Parsons, C. A.	£1	52/6xr		10	10	—	—	—
Plessey	10/-	61/-	−3d	27½	30	4 18 3	87/6	56/-
Pye "A" Deferred	5/-	16/3	+9d	12½	12½	3 17 0	21/3	13/3
Reyrolle	£1	91/3xr		15	16½	3 11 3	117/6	81/-
Rheostatic	4/-	9/-		18½	12†	5 6 9	—	8/3
Richardsons Westgarth	5/-	17/3	+1/6	16⅝	16⅝	4 16 6	17/-	13/9
Scottish Cables	4/-	15/3		27½	27½	7 4 3	17/9	14/9
Smith (England), S.	4/-	12/9	+1/6	17½	17½	5 9 9	14/3	10/6
Southern Areas	£1	13/9		10	7½	10 18 3	28/9	13/9
Strand Elec.	5/-	7/9		15	15	9 13 6	8/6	6/9
Sturtevant	5/-	23/6	+1/6	14·4†	15†	3 3 9†	31/3	21/3
Sun Elec.	£1	42/6		20	25	11 15 3	42/6	33/9
Switchgear & Cowans	5/-	13/-	+3d	20	25	9 12 3	17/-	12/9
Taylor Tunnicliff	5/-	11/9		15	15	6 7 9	14/-	11/3
T.C.C.	10/-	33/9		25	25	7 8 3	45/-	33/9
T.C. & M.	£1	24/6	+6d	8½	8½	6 18 9	34/-	24/-
Telephone Mfg.	5/-	6/6		10	10*	7 13 9	8/6	6/-
Thorn Elec.	5/-	16/-	+3d	15	15	4 13 9	22/6	15/-
Thornycroft	£1	33/9	−9d	15	12½	7 8 3	49/9	33/6
Tube Investments	£1	57/6	+2/6	22½	15*‡	5 4 3	70/6	50/9
Vactric	5/-	13/-		15	17½*	6 14 6	15/-	11/-
Veritys	5/-	9/3	+9d	12½	12½	6 15 3	10/-	6/9
Walsall Conduits	4/-	11/6		70	20*	6 19 3	13/6	10/9
Ward & Goldstone	5/-	37/6	+1/3	30	35	4 13 3	39/6	29/-
Watford	2/-	6/-		25	25	8 6 9	7/6	5/6
Westinghouse	£1	68/9	+1/3	18	18	5 4 9	100/-	67/6
West, Allen	5/-	12/-	+6d	15	15	6 5 0	14/6	11/3
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Portuguese	£1	21/3	+6d	8	8	7 10 6	23/6	20/3
Brit. Elec. Traction: Def. Ord. "A"	5/-	18/-	+2/-	22½	22½	6 5 0	20/-	15/6
Cable & Wireless: Ord.	5/-	9/6		10	10	5 5 3	11/3	9/3
4% Loan	100	90½xd		4	4	4 8 6	92½	88
Calcutta Trams	£1	23/9	−1/3	7½†	8½†	7 3 3†	27/6	23/-
Cape Elec. Trams	£1	15/6	−9d	8	8	10 6 6	20/3	16/3
Marconi Marine	£1	31/6	+6d	10	10	6 7 0	34/-	31/-
Oriental Tel. Ord.	1/-	67/6		16	—	—	90/-	66/3
Telephone Rentals	5/-	10/3	+6d	12½	12½	6 2 0	11/9	9/6

Better Prices

Crompton Parkinsons went further ahead during the latter half of December, being dealt in up to 14s 9d (the official quotation remained 1s lower). Among other electrical issues in the main atomic power groups, English Electric added 1s 3d to previous gains. Of the engineering shares associated with the nuclear programme Babcock & Wilcox reacted by a few shillings to 73s 9d, but Clarke Chapmans put on another 7s 6d, to 127s 6d, Richardsons Westgarth improved further to 17s 3d, Simon-Carves to 26s 6d and International Combustion to 20s. Elsewhere, gains of up to half-a-crown or so appeared fairly plentifully in the electrical lists. Some of the best recoveries were shown by B.I.C.C., Associated Automation, British Tabulating, Johnson & Phillips and Morphy-Richards.

Decca Dividends

A rise of 1s 9d in the price of Decca Record 4s "A" shares over the past three weeks reflected the expectation of satisfactory news when the company announces the final dividend and the preliminary statement of results for the year ended in March. These appeared last time in the middle of January, and the chairman's review, a month later, included an encouraging account of business during nine of the twelve months for which the full results are now due. The two interim dividends for 1955–56 have been maintained at the same rate as before on capital increased by a "rights" issue. If the final rate is similarly maintained the total will be 1s 9d per share, and the yield on the "A" shares, at 28s 9d, a little over 6 per cent. The quotation was under 24s only a month ago.

Motor Accessories

Investments connected with the motor industry registered a measure of satisfaction with the Government's decision to ease the hire-purchase terms for cars. Shares of the accessory manufacturing companies have been supported also on evidence of the success with which some of the firms have diversified their interests so as to reduce their dependence upon orders from the motor industry. This point was underlined by Mr. Gordon-Smith at the annual meeting of S. Smith & Sons, although he reminded shareholders that since motor accessories remained an important side of the business, the outlook for the company was still affected by the uncertainty of the motor trade's future. In recent weeks the company's 4s shares have recovered well to over 13s in the market.

REPORTS and DIVIDENDS

Brook Motors, Ltd.—The annual meeting was held on 22nd December, Mr. F. V. Brook (chairman and joint managing director) presiding. In his circulated statement, Mr. Brook referred to the circumstances which resulted in the forecast of profits expected on the year not being fulfilled. He said that at that time it was impossible to visualise the change in conditions as they appeared at the end of the financial year. The directors had taken the necessary steps to rectify the position. The American company's operating costs were improving each month, and he predicted satisfactory results at the end of the current financial year. Trading conditions overseas were difficult, but fortunately Dominion and Commonwealth countries still remained the backbone of their markets.

They were planning to expand their production by the establishment of a new factory between the Huddersfield and Barnsley factories which should be in full operation towards the end of 1957. The production of f.h.p. motors and motor units required for the refrigeration industries would be the main function of the new factory.

The General Cable Manufacturing Co., Ltd., is paying a second interim dividend of 18 per cent, in lieu of a final payment, making a total for the year to 30th September last of 30 per cent (unchanged).

Richardsons, Westgarth & Co., Ltd., have made an offer for the capital of the Humber Graving Dock & Engineering Co., Ltd., in exchange for an issue of fully paid shares in Richardsons, Westgarth. The offer, if accepted, will increase the issued capital of Richardsons, Westgarth, by 900,000 stock units of 5s each. It is open until 14th January and is conditional upon the acceptance by holders of not less than 90 per cent of the Humber company's capital, or such lesser percentage as Richardsons, Westgarth, may decide to accept.

Associated Engineering Holdings, Ltd., reports group profits for the year ended 30th September last of £2,728,861, as compared with £2,505,478 for the preceding year, and after providing for taxation of £1,201,986, the net balance is £1,051,325 (against £997,840), of which £1,048,953 is attributable to the parent company. It is proposed to pay a final dividend of 15 per cent, maintaining the distribution for the year at 20 per cent. General reserves of subsidiaries receive £500,000 and £334,476 is carried forward (against £237,691 brought in).

Murex, Ltd., is maintaining its interim dividend at 7½ per cent.

New Companies

Electrical Insulation Co., Ltd.—Registered 5th December. Capital £100. Manufacturers, convertors and merchants of and dealers in insulating, arc, heat and water resisting materials of all kinds, etc. Regd. office: Market Chambers, Radcliffe, Nr. Manchester.

Eric Scurrah, Ltd.—Registered 19th November. Capital £5,000. Dealers in and servicers of radio-telegraphy, radio-telephony, television, radar and other electronic sets, equipment and apparatus, etc. Directors: E. Scurrah and Mrs. Edith M. Scurrah. Regd. office: 152, Hunsworth Lane, Cleckheaton.

Exproduct, Ltd.—Registered 22nd November. Capital £1,000. Electrical engineers and contractors, etc. Directors: S. Scheeres, D. Robertson and F. Brown. Regd. office: 44, Glamorgan Street, Cardiff.

Ashby Electrical Wholesale, Ltd.—Registered 14th November. Capital £1,000. To acquire the business of a wholesaler of and dealer in electrical equipment carried on at Chelsea by Mrs. Maud B. Ashby, etc. Directors: Mrs. Maud B. Ashby and H. F. Crook. Regd. office: 18, Cale Street, Chelsea, S.W.3.

Wesgar, Ltd.—Registered 20th November. Capital £100. Manufacturers and repairers of and dealers in dynamos, motors, armatures, magnetos, etc. Directors: W. B. Westgate, F. O. Grafton and C. W. Westgate. Regd. office: 47, Great Eastern Road, E.15.

W. Newton (Radio), Ltd.—Registered 21st November. Capital £1,000. Dealers in radio, television and telephone apparatus, etc. Directors: W. Newton and Eveline M. Newton. Regd. office: 237, Stratford Road, Shirley, Solihull, Warwicks.

R. P. Turner & Co., Ltd.—Registered 21st November. Capital £2,000. Consultants in mechanical, electrical and electronic engineering, etc. Directors: R. P. Turner and Bertha R. Turner. Regd. office: 80, Dobcroft Road, Sheffield, 7.

Cotterill-Ginn, Ltd.—Registered 27th November. Capital £100. Electricians, electrical and mechanical engineers, etc. Directors: W. R. Cotterill and D. Ginn. Regd. office: 68, Park Road, Hornsey, N.8.

F. P. Rout & Co., Ltd.—Registered 23rd November. Capital £100. Instrument, mechanical, electrical and electronic engineers, etc. Directors: F. P. Rout and Mrs. Margaret E. Rout. Regd. office: 300, Ballards Lane, North Finchley, N.12.

Grimwood (Croydon), Ltd.—Registered 19th December. Capital £2,000. To take over the business carried on by C. L. Grimwood at 59-65, Cross Road, Croydon, Surrey, and to carry on the business of manufacturers of electrical and mechanical workers, metal pressers, manufacturers of electrical heating elements, etc. Directors: C. L. Grimwood and Mrs. Winifred R. Grimwood. Regd. office: 59, Cross Road, Croydon, Surrey.

Burkem Electrics, Ltd.—Registered 6th November. Capital £100. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: M. Burke and K. Burke. Regd. office: 61, Portland Place, W.1.

Winston Rentals, Ltd.—Registered 6th November. Capital £100. Electricians, electronic engineers, radio and television engineers and contractors, etc. Regd. office: Covett Avenue, Shepperton, Mdx.

Parker, Webb & Co., Ltd.—Registered 31st October. Capital £3,000. Manufacturers of and dealers in electrical accumulators, batteries, acids and containers, dynamos, motors, transformers, magnetos and electrical plant, etc. Directors: L. C. Webb, J. H. Webb and E. E. Parker.

Scientific Automation Engineering Co., Ltd.—Registered 1st November. Capital £1,000. Automation, scientific instrument and electronic and nucleonic engineers, etc. Directors: Mrs. Margaret Morgan and F. Lennon (secretary). Regd. office: 5-7, New York Road, Leeds.

R. W. Radio Services, Ltd.—Registered 1st November. Capital £100. Manufacturers of and dealers in electrical goods, equipment and apparatus of all kinds, etc. Directors: D. L. Reeves (secretary) and J. Wooldridge. Regd. office: 77, Portman Place, London, W.1.

Texas Electronics, Ltd.—Registered 12th November. Capital £40,000. Electrical and mechanical engineers and instrument makers, and in particular manufacturers of transistors, photo-transistors, diodes, etc. Regd. office: 18, Austin Friars, E.C.2.

Increase of Capital

Electrical Components, Ltd.—Increased by £400,000, in 5s ordinary shares, beyond the registered capital of £350,000.

Bankruptcy

J. G. Sims, 57, Over Lane, Openwoodgate, Belper, Derbyshire, trading as J. G. S. Radio Service, radio and television retailer and electrical contractor.—Public examination 19th March at the Court House, 20, St. Peter's Church Yard, Derby.

Rating and Valuation

Before Parliament rose for the Christmas Recess Mr. Duncan Sandys, Minister of Housing and Local Government, introduced in the House of Commons the Rating and Valuation Bill which adjusts the rate payments to be made by the nationalised gas, electricity and transport industries. This is being done to prevent a sharp fall in rate revenue which local authorities would have suffered as a result of the recent revaluation of property. It is proposed that the Bill shall take effect from 1st April next.

Mr. Sandys said the revaluation had placed an "unduly heavy share" on occupiers of shops and other commercial property and the Bill proposed that the r.v. of such premises should be reduced by 20 per cent.

Mr. Page asked whether the Minister had any plan for the proper rating of premises and showrooms owned by the nationalised industries, which some regarded as being perhaps unfairly rated.

Mr. Sandys said that the Government recognised the need for improvements in the manner of rating the nationalised industries, including the question of the separate rating of showrooms. Since these changes could not reasonably be brought into effect between now and 1st April they were not included in this interim measure. He would have more to say about them when he made a fuller statement on local government finance in January.

(The effect of the Bill upon the electricity supply industry is that from 1957-58 the rate payments will be about the same as they were before the revaluation. Rates are paid in the form of pool payments calculated on a national formula. Since revaluation the pool payments have fallen.)

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 9th January from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1947

21397. Standard Telephones & Cables, Ltd.—Wave converting systems. 6th August, 1947. (765780.)

1952

7772. General Electric Co., Ltd.—Apparatus for obtaining measurements of the frequency of electric oscillations. 19th June, 1953. (765453.)

24858. Time, Inc.—High frequency carrier system for electronic colour correction system. 3rd October, 1952. (765443.)

30938. Siemens & General Electric Railway Signal Co., Ltd., and Candler, J. E.—Electromagnetic relays. 1st December, 1953. (765661.)

32850. Brennan, J. B.—Securing together members of electrically insulating and conductive materials respectively. 29th December, 1952. (765554.)

1953

6712. British Thomson-Houston Co., Ltd.—Fluorescent coating compositions. 11th March, 1953. (765674.)

7831 & 7833. Standard Telephones & Cables, Ltd.—Electrical intelligence storage equipment. 20th March, 1953. (765664 & 765666.) 7832. Timing equipment. 20th March, 1953. (765665.)

10971. Castelco (Great Britain), Ltd., and Schneider, H. W.—Rotary electric switches. 14th April, 1954. (765556.)

17952. General Electric Co.—Defrosting arrangement for refrigerating systems. 29th June, 1953. (765559.)

18308. Whipp & Bourne, Ltd., and Whipp, C. L.—Withdrawable electric switchgear such as circuit-breakers. 30th September, 1954. (765214.)

18842. I-T-E Circuit Breaker Co.—Commutating reactors for mechanical rectifiers. 7th July, 1953. (765737.) 20101. Contact time adjustment for mechanical rectifiers. 20th July, 1953. (765738.) 20102. Adjusting mechanical rectifier contacts. 20th July, 1953. (765739.)

23743. Bolesta, D.—Generation of power. 27th August, 1953. (765216.)

27391. Pye, Ltd.—Electromagnetic relays. 6th October, 1954. (765461.)

29852. Metropolitan-Vickers Electrical Co., Ltd.—Electrical switchgear. 20th October, 1954. (765219.)

30808. Compagnie Générale d'Electricité.—Process for the manufacture of a protective sheath for electrical conductors, the sheath being made of glass yarns. 6th November, 1953. (765463.)

31094. Standard Telephones & Cables, Ltd.—Telecommunication system. 10th November, 1953. (765681.)

31592. Standard Telephones & Cables, Ltd.—Radio wave guide systems. 5th November, 1954. (765465.)

35167. Jackson Electric Stove Co., Ltd.—Door securing devices. 2nd November, 1954. (765343.)

36375. General Electric Co., Ltd., and Beesley, J. H.—Electrical gas discharge tube circuits. 16th December, 1954. (765680.)

1954

803. Elliott Bros. (London), Ltd.—Electrical measuring instruments. 11th January, 1955. (765682.)

1099. Fielden Electronics, Ltd.—Electrical amplifiers. 7th April, 1955. (765683.)

1834. Levell, D. A.—Blocking oscillator circuits. 7th January, 1955. (765472.)

1992. British Thomson-Houston Co., Ltd.—Steam turbine plant. 24th January, 1955. (765223.)

2028. Standard Telephones & Cables, Ltd.—Electric phase discriminating arrangements. 14th January, 1955. (765685.)

2283. Cole, Ltd., E. K., and Hutchings, E. L.—Supporting means for electric lamps. 26th January, 1955. (765567.)

2742. English Electric Co., Ltd.—Shrouds for the protection of connections between electrical conductors. 28th January, 1955. (765686.)

2769. Philips Electrical Industries, Ltd.—Transistor elements and transistor circuits. 29th January, 1954. (765568.)

3139. Ferguson Radio Corporation, Ltd.—Electromagnetic relays. 1st February, 1955. (765569.)

4062. Dowty Equipment, Ltd.—Snap-action electric switches. 11th February, 1955. (765474.)

5732. Standard Telephones & Cables, Ltd.—Electric contact spring assembly. 26th February, 1954. (765571.)

6560. Singleton, S. A.—Electric temperature sensitive switch devices for fire alarms. 4th March, 1955. (765572.)

6751. Decca Record Co., Ltd.—Radio navigation systems. 7th March, 1955. (765573.)

9478. Sangamo Weston, Ltd.—Electrical contact arrangements especially for meteorographic apparatus. 31st March, 1954. (765346.)

10489. Philips Electrical Industries, Ltd.—Methods of locally heating hollow objects. 9th April, 1954. (765347.)

10628. Hollander, J. M.—Electro-magnetic switches. 13th June, 1955. (Addition to 731931.) (765575.)

11129. Chamberlain & Hookham, Ltd., Deacon, L. O., and Lewis, H. S.—Protective means for use in electric power systems. 23rd March, 1955. (765689.)

12204. British Telecommunications Research, Ltd.—Telegraph distributors. 15th April, 1955. (765227.)

14173. Research Corporation.—Automatic control systems for high voltage d.c. supply to electrostatic precipitators and transformers especially suited to use in such systems. 14th May, 1954. (765228.)

15012. English Electric Co., Ltd.—Electrical fusegear. 20th May, 1955. (765577.)

15081. Kolster-Brandes, Ltd.—Automatic gain control circuits in television receivers. 20th May, 1955. (765691.)

16278. McGeoch & Co., Ltd., W.—Electric lampholders. 2nd June, 1955. (765484.)

17293. Standard Telephones & Cables, Ltd.—Radiation amplifiers. 11th June, 1954. (765579.)

17294. Standard Telephones & Cables, Ltd.—White-limiter arrangements in television transmitters. 11th June, 1954. (765580.)

18164. British Thomson-Houston Co., Ltd.—Operating mechanism for electric circuit-breakers. 20th June, 1955. (765697.)

18369. Crabtree & Co., Ltd., Wintle, T. D. G., and Middleton, E.—Multi-pole electric switches. 24th March, 1955. (765698.)

18371. Crabtree & Co., Ltd., J. A., and Middleton, E.—Interlocking mechanism for enclosed electric switches. 17th June, 1955. (765699.)

18431. Marx, E.—Electrical terminals or connectors for wires. 23rd June, 1955. (765751.)

19052. Licentia Patent-Verwaltungs-Ges.—Contact rectifier with commutating reactors and means for the control of the d.c. voltage. 29th June, 1954. (765703.)

19534. Soc. d'Electronique et d'Automatisme.—Electric multiplying devices and electric adder circuits. 2nd July, 1954. (765704.)

20188. Siemens Bros. & Co., Ltd.—Joints in electric cables. 8th July, 1955. (765705.)

21215. Ferranti, Ltd.—Glass-to-metal seals. 18th July, 1955. (765584.)

21907. Metropolitan-Vickers Electrical Co., Ltd.—Magnetic coupling devices including clutches and brakes. 25th July, 1955. (765586.)

22494. Pyrotenax, Ltd.—Apparatus for straightening wires or cables. 29th July, 1955. (765707.)

22826. Kaiser Aluminum & Chemical Corporation.—Electrical connections between aluminium and copper conductors. 5th August, 1954. (765754.)

23179. Signal-Stat Corporation.—Snap-action electric switches. 10th August, 1954. (765755.)

23272. Selectra, Ltd., and Krebs, E. W.—Heteropolar inductor alternators. 28th July, 1955. (765588.)

25001. Malvica, S. Bosco-.—Electromagnets. 27th August, 1954. (765448.)

25277. Hay, W. O., Wylie, A. E., Malone, J., and Faber, T. F.—Room electric heater. 31st August, 1954. (765709.)

25849. Hoover, Ltd.—Thermostatic control means particularly for electric irons. 5th September, 1955. (765234.)

27211. Clarke, Chapman & Co., Ltd., and Howlett, F. C.—Electrical control systems for d.c. motors. 14th September, 1955. (765594.)

29602. Ekman, O. I. H.—Electric fire alarm and circuit fault control system. 14th October, 1954. (765491.)

29629. Philips Electrical Industries, Ltd.—Sequential colour television and like systems. 14th October, 1954. (765598.)

32254. Philips Electrical Industries, Ltd.—Magnetic separators. 8th November, 1954. (765495.)

37121. Telefonaktiebolaget L. M. Ericsson.—Devices for selecting and transforming time phase modulated pulse trains. 22nd December, 1954. (765238.)

37278. Zahnradfabrik Friedrichshafen Akt.-Ges.—Electric remote control arrangements for transmitting a plurality of control signals or connections. 23rd December, 1954. (765503.)

37378. International Business Machines Corporation.—Transistor bistable latch circuits. 24th December, 1954. (765381.)

37381. Binary trigger circuit. 24th December, 1954. (765382.)

37480. G-V. Controls, Inc.—Electrothermally actuated control devices. 28th December, 1954. (765610.)

1955

551. Philips Electrical Industries, Ltd.—Radio receiving apparatus. 7th January, 1955. (765508.)

1400. Soc. de Traitements Electro-Chimiques de l'Ouest S.T.E.C.O.—Manufacture of electric storage battery plates. 17th January, 1955. (765297.)

1520. Scintilla, Ltd.—Delay action switch mechanism. 18th January, 1955. (765242.)

2550. Soc. de la Pile Leclanche.—Electric batteries and methods for the manufacture thereof. 27th January, 1955. (765766.)

[*Continued on next page*

NEW PATENTS (*Continued*)

3266. Siemens & Halske Akt.-Ges.—Teleprinter machines having alternatively operable transmitting arrangements. 3rd February, 1955. (765245.)

3322. Compagnie Electro-Mecanique.—Anti-rebound devices particularly for the movable contacts of circuit-breakers. 4th February, 1955. (765765.)

3339. Hellström, G. L.—Snap-action electric switches. 4th February, 1955. (765307.)

3380. Ges. für Linde's Eismaschinen Akt.-Ges.—Method of electric arc spot-welding. 4th February, 1955. (765248.)

3979. Allmanna Svenska Elektriska Aktiebolaget. — Hydraulic operating device especially for electric circuit-breakers. 10th February, 1955. (765524.)

4100. Arrow Electric Switches, Ltd.—Combined electric switch and circuit-breaker device. 11th February, 1955. (765252.)

4153. Philips Electrical Industries, Ltd.—Flashlight lamps. 11th February, 1955. (765314.)

4696. Fligue, W. De.—Double pole electro-magnetic switching device. 16th February, 1955. (765256.)

4803. General Electric Co.—Suction cleaners. 17th February, 1955. (765320.)

4825. Gottfried, S.—Devices for stripping electric cables. 17th February, 1955. (765395.)

4922. Philips Electrical Industries, Ltd.—Transistor circuits having variable amplification. 18th February, 1955. (765398.)

4959. General Electric Co.—Induction reactors. 18th February, 1955. (765258.)

5217. Westinghouse Electric International Co.—Screens for producing an electron image. 22nd February, 1955. (765265.)

5286. Tilch, E.—Pressure operated electrical switches. 22nd February, 1955. (765403.)

5434. Philips Electrical Industries, Ltd.—Subscribers line circuit arrangements. 23rd February, 1955. (765404.)

5435. Philips Electrical Industries, Ltd.—Electric incandescent lamps. 23rd February, 1955. (765405.)

5701. Western Electric Co., Inc.—Electrical contacts. 25th February, 1955. (765273.)

5724. Akt.-Ges. Brown, Boveri & Cie.—Magnetic trip with short time-lag-release. 25th February, 1955. (765411.)

5738. Höhn, R.—Multi-strand electrical conductors. 25th February, 1955. (765412.)

5818. Westinghouse Electric International Co.—Automatic electric circuit-breakers. 28th February, 1955. (765276.)

6055. Compagnie Générale d'Electricité.—Process for the manufacture of high tension electric cables. 1st March, 1955. (765420.)

6072. General Electric Co.—Eddy current coupling devices. 1st March, 1955. (765421.)

6407. Westinghouse Air Brake Co.—Electric control apparatus for railway car retarders. 4th March, 1955. (765428.)

6485. General Electric Co.—Centrifugally operated mechanisms, such as motor starter switches. 4th March, 1955. (765720.)

6619. Fairbanks, Morse & Co.—Electric motor. 7th March, 1955. (765620.)

6768. Westinghouse Electric International Co.—Electric circuit-breakers or switches. 8th March, 1955. (765724.)

7060. Philips Electrical Industries, Ltd.—Inductance coil arrangements. 10th March, 1955. (765546.)

7118. Outillage Electrique Silex.—Rotors of electric motors. 10th March, 1955. (765627.)

7372. Philips Electrical Industries, Ltd.—Amplifier circuits. 14th March, 1955. (765634.)

7512. Jarrett, A. W.—Method of and tool for branching conductors from flexible electric cables. 5th September, 1955. (765640.)

7821. Westinghouse Electric International Co.—Electric circuit interrupters. 17th March, 1955. (765287.)

8404. Westinghouse Electric International Co.—Control systems for elevator cars. 23rd March, 1955. (765439.)

8451. Western Electric Co., Inc.—Automatic apparatus for adjusting and testing polar electromagnetic relays. 23rd March, 1955. (765289.)

8845. Siemens-Schuckertwerke Akt.-Ges.—Electric contact convertors. 25th March, 1955. (765643.)

9009. British Thomson-Houston Co., Ltd.—Transmission and reception of ultra high frequency electromagnetic energy. 28th March, 1955. (765645.)

36431 and 36561. Siemens & General Electric Railway Signal Co., Ltd., and Candler, J. E.—Electromagnetic relays. 1st December, 1953. (Divided out of 765661.) (765662-3.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 19th January:—

No. 751,712 (design). Class 9. Gauges employing radioactive isotopes for use in measuring the physical properties of materials; and electronic apparatus incorporating such gauges.—Industrial Nucleonics Corporation, Columbus, Ohio, U.S.A. Address for service, c/o Boult, Wade & Tennant, 112, Hatton Garden, London, E.C.1.

MORGANOHM. No. B754,124. Class 9. Electrical apparatus and instruments and parts.—Morgan Crucible Co., Ltd., Battersea Church Road, London, S.W.11.

PLES. No. B756,400. Class 9. Electric condensers.—Plessey Co., Ltd., 56, Vicarage Lane, Ilford.

ISOLBLAST. No. 756,668. Class 9. Electrical switchgear.—British Thomson-Houston Co., Ltd., Crown House, Aldwych, W.C.2.

MANDAW (design). No. 758,737. Class 9. Electric batteries, electric cells and accumulators; radio apparatus operated by electric batteries, electric cells and by accumulators; and cases for electric torches.—Ever Ready Co. (Great Britain), Ltd., Hercules Place, N.7.

Malayan Electrical Imports

After a substantial rise during 1954 to some 69 million Malayan dollars, Malayan electrical imports again increased by 29 per cent last year. The United Kingdom, in spite of increasing foreign competition, is still by far the greatest supplier, with a share of 56·5 per cent. Details of the trade are given in the following tables. ($1=2s 4d.)

Imports of Principal Products ($000)

Product	1954	1955
Generators	1,339	6,141
From United Kingdom	1,091	6,014
Motors up to 25 h.p.	717	757
From United Kingdom	646	547
Ditto, 25–100 h.p.	390	147
From United Kingdom	376	128
Ditto, above 100 h.p.	533	228
From United Kingdom	525	228
Switch and control gear	2,931	3,528
From United Kingdom	2,921	3,525
Parts of alternators, motors, transformers and switchgear	4,420	5,019
From United Kingdom	4,275	4,860
Transformers, reactors and inductors	1,880	2,575
From United Kingdom	1,738	2,242
,, *United States*	99	235
Radio and television receivers	4,085	7,865
From United Kingdom	608	622
,, *W. Germany*	473	2,422
,, *Holland*	2,975	4,702
Transmitters and radio communication equipment	1,708	1,286
From United Kingdom	1,201	1,034
,, *Australia*	367	242
Radio valves	236	470
From United Kingdom	121	137
Radio parts and accessories	2,032	2,566
From United Kingdom	1,200	1,477
,, *W. Germany*	72	212
,, *Holland*	425	626
,, *United States*	301	179
Telephone and telegraph apparatus	5,667	5,817
From United Kingdom	5,637	5,795
Electric filament lamps	1,386	1,597
From United Kingdom	887	969
,, *Holland*	437	461
Cooking appliances	1,165	1,851
From United Kingdom	1,055	1,717
Heating appliances	956	1,237
From United Kingdom	912	1,096
Flat irons	546	686
From United Kingdom	503	620
Ceiling fans	2,263	2,421
From United Kingdom	1,897	1,371
,, *India*	250	566
,, *Italy*	—	419
Table fans	592	874
From United Kingdom	260	287
,, *Japan*	212	458
Other domestic elec. appliances	568	528
From United Kingdom	412	387
,, *United States*	93	73
Welding equipment	191	240
From United Kingdom	83	131
Ignition coils	449	1,064
From United Kingdom	399	838
Cycle lighting sets	4,459	1,890
From United Kingdom	1,233	428
,, *W. Germany*	1,557	665
,, *Holland*	56	272
,, *Japan*	1,086	520
Torch batteries	1,282	1,756
From United Kingdom	345	1,371
,, *India*	—	284
Accumulators	2,918	4,098
From United Kingdom	2,146	2,877
,, *Australia*	453	439
,, *W. Germany*	280	597
Meters (supply)	1,449	995
From United Kingdom	1,447	991
Measuring, controlling and safety appliances	252	497
From United Kingdom	204	339
Cables and wires, rubber insulated (excl. telephone and telegraph)	6,165	8,085
From United Kingdom	5,796	7,166
,, *W. Germany*	92	393
,, *Italy*	86	100
,, *Japan*	30	384
Ditto, insulated with other than rubber (except telegraph)	2,449	4,064
From United Kingdom	2,240	3,833
,, *Japan*	65	156
Telephone and telegraph submarine cables (all U.K.)	2,891	1,872
Parts of electrical machinery	933	790
From United Kingdom	734	599
,, *Switzerland*	100	119
Machinery and appliances, n.e.s.	3,715	4,986
From United Kingdom	2,919	3,820
,, *Hong Kong*	149	216
,, *W. Germany*	182	205

Malayan Imports by Country ($)

Country	1954	1955
United Kingdom	50,798,866	62,760,092
Canada	64,644	98,954
Hong Kong	981,347	1,884,163
India	311,601	193,000
Australia	1,496,947	1,221,621
Austria	29,305	103,973
Belgium	74,749	151,017
Czechoslovakia	25,099	17,256
Denmark	44,593	57,472
France	30,672	25,573
West Germany	3,377,016	6,309,614
Italy	187,708	659,266
Holland	6,165,767	8,952,394
Sweden	192,142	473,614
Switzerland	157,457	12,105
U.S.A.	3,348,799	3,756,650
Japan	1,715,701	2,443,575

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 7th January

BIRMINGHAM.—James Watt Memorial Institute, 6 p.m. I.E.E. South Midland Centre. "Recruiting to the Engineering Profession." (Combined meeting with the Education Discussion Circle.)

HULL.—Y.E.B. Lecture Theatre, Ferensway, 7 p.m. I.E.S. Leeds Centre. "Light and its Effect on Plant Growth," by S. S. Beggs.

ILFORD.—Angel Hotel, 7.30 p.m. A.S.E.E. North East London Branch. "Electricity as Applied to the Aircraft Industry," by C. G. Hayward.

LEEDS.—Great Northern Hotel, 7.30 p.m. A.S.E.E. Leeds Branch. Films.

LIVERPOOL.—Royal Institution, Colquitt Street, 6.30 p.m. I.E.E. Mersey and North Wales Centre. Informal discussion on "The Institution's Wiring Regulations (13th Edition)," opened by Forbes Jackson.

The Temple, Dale Street, 6.30 p.m. The Institute of Marine Engineers, Merseyside & North Western Section. "Some Aspects of A.C. Auxiliaries for Marine Use," by Cdr. D. W. Malim, R.N. (ret.).

LONDON.—Caxton Hall, S.W.1, 7 p.m. E.P.E.A., London Technical Group. "Radioactive Techniques in Industry," by J. L. Putman.

At the I.E.E., Savoy Place, W.C.2, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. "Auto Exchange Maintenance Procedure—Past, Present and Future," by S. Rudeforth, K. S. Laver and E. R. Driver.

NEWCASTLE-UPON-TYNE. — County Hotel, Neville Street, 6.30 p.m. North East Electrical Club. "A Visit to the New State of Israel," by Major W. Poulson.

SHEFFIELD.—Royal Victoria Station Hotel, 7.30 p.m. A.S.E.E. Sheffield Branch. Films.

STAFFORD.—Technical College, 7.15 p.m. I.E.E. North Staffs. Sub-Centre Graduate and Student Section. Senior chairman's address, "Transformers," by A. T. Chadwick.

Tuesday, 8th January

BELFAST.—Queen's University, 6.30 p.m. I.E.E. Northern Ireland Centre. "New Development in High Frequency Electric Motors," by C. Snowden.

EDINBURGH.—25, Charlotte Square, 7 p.m. Incorporated Plant Engineers, Edinburgh Branch. "Electronics in Industry," by R. B. Smith.

Scottish Lyceum Gallery, 11, Atholl Crescent, 7.30 p.m. Edinburgh Electrical Society. "Transformer On-load Tap Change Equipment," by A. N. Scott.

HAMMERSMITH. — Windsor Castle Hotel, 134, King Street, 7.30 p.m. A.S.E.E. West London Branch. "Generation of Electricity by Nuclear Energy," by J. R. M. Southwood and J. Thompson.

LEEDS.—C.E.A., Yorkshire Division, 1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Centre. Discussion on "Recruitment in the Electrical Industry," opened by Dr. E. C. Walton. (Joint meeting with Education Discussion Circle.)

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurement and Radio Sections. "A Theoretical and Experimental Investigation of Anisotropic-Dielectric-Loaded Linear Electron Accelerators," by R. B. R. Shersby-Harvie, L. B. Mullett, W. Walkinshaw, J. S. Bell and B. G. Loach (joint meeting).

I.E.E. London Graduate and Student Section. Visit to Waterloo Station signal box at 6.45 p.m.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club. Luncheon. Speaker, J. Eccles.

Lighting Service Bureau, 2, Savoy Hill, 6 p.m. Illuminating Engineering Society. "Lighting as an Effective Aid to Architecture," by H. R. Ruff, H. E. Bellchambers and R. V. Mills.

MANCHESTER.—Engineers' Club, 17, Albert Square, 6.15 p.m. I.E.E. North-Western Centre. "Measurement of Earth Loop Resistance," by Dr. G. F. Tagg.

NOTTINGHAM.—College of Art & Crafts, Waverley Street, 6.30 p.m. I.E.E. East Midland Centre. "Electrical Energy from the Wind," by E. W. Golding.

READING.—Palmer Hall, West Street, 7.15 p.m. A.S.E.E. Oxford, Reading & Districts Branch. "Earth Leakage Equipment," by J. A. Robbins.

RUGBY.—College of Technology and Arts, 6.30 p.m. I.E.E. Rugby Graduate and Student Section. "Performance and Application of Magnetic Amplifiers," by J. W. S. Payne.

Tuesday, 8th January, and Wednesday, 9th January

SOUTHAMPTON.—The University. Institution of Production Engineers, Southern Section. Conference on "Problems of Aircraft Production."

Wednesday, 9th January

ABERDEEN.—Caledonian Hotel, 7.30 p.m. I.E.E. North Scotland Sub-Centre. "Colour Television," by Dr. G. N. Patchett.

BIRMINGHAM.—James Watt Memorial Institute, 6.30 p.m. I.E.E. South Midland Graduate and Student Section. Students' lecture: "Digital Computers and how they may help the Engineer," by Dr. M. V. Wilkes.

Birmingham Exchange & Engineering Centre, Stephenson Place, 7.30 p.m. A.S.E.E. Birmingham Branch. "Properties of Silicones and their Application in Electrical and Engineering Industries," by J. J. Newlands and G. O. Towers.

BRADFORD.—Midland Hotel, 8 p.m. A.S.E.E. Bradford Branch. "Earthing Systems."

BRIGHTON.—Brighton Technical College, 6.30 p.m. I.E.E. Southern Centre. "Crystal Palace Television Transmitting Station," by F. C. McLean, A. N. Thomas and R. A. Rowden.

BRISTOL.—Grand Hotel, 7.15 p.m. Incorporated Plant Engineers, Western Branch. "Factory Electrical Distribution Systems," by R. H. Cobbold.

CHELMSFORD.—Mid-Essex Technical College, 7.30 p.m. Institution of Production Engineers, South Essex Region. "Electronic Computer Control of Machine Tools."

EDINBURGH.—Y.M.C.A., 14, South St. Andrew Street, 6.15 p.m. I.E.S. Edinburgh Centre. "Electrical Contractor's Approach to Artificial Lighting," by E. Cassidy.

HALIFAX.—Crown Hotel, Horton Street, 7.30 p.m. A.S.E.E. Halifax Branch. "Further Thoughts on Television," by H. B. Reeder.

LONDON.—University College, W.C.1, 7.30 p.m. Radar Association. "Problems and Techniques of High Energy Physics," by J. R. Atkinson.

At the St. Bride Institute, Bride Lane, E.C.4, 6.30 p.m. Institution of Engineers-in-Charge. "Automatic Level Control in Boilers," by Sir Harold Roxbee Cox.

NEWCASTLE-UPON-TYNE. — King's College, 6.15 p.m. I.E.S. Newcastle-upon-Tyne Centre. "Lighting of Small Factories," by J. S. McCulloch.

NORTHAMPTON. — College of Technology, 7.15 p.m. Northampton and District Electrical Association. "A Navigational Aid for Ships and Aircraft," by C. Powell.

NOTTINGHAM. — County Hotel, Theatre Square, 7 p.m. Incorporated Plant Engineers, East Midlands Branch. "Severn Barrage Scheme," by B. D. Richards.

OXFORD.—Southern Electricity Board, 37, George Street, 7 p.m. I.E.E. Oxford District meeting. "Fuel and the Future," by Sir Francis E. Simon.

PRESTON.—North Western Electricity Board Demonstration Theatre, 19, Friargate, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. "Highland Water Power—Developments of the North of Scotland Hydro-Electric Board," by the late T. Lawrie, to be read by C. L. C. Allan.

SWANSEA.—Demonstration Theatre, South Wales Electricity Board, The Kingsway, 6.30 p.m. I.E.S. Swansea Group. "Maintenance of Lighting Installations," by J. W. Strange.

WOLVERHAMPTON. — Wolverhampton & Staffordshire Technical College, Wulfruna Street, 7.15 p.m. British Institution of Radio Engineers, West Midlands Section. "Design and Application of Magnetic Amplifiers," by R. G. Russell-Bates.

Thursday, 10th January

CHELMSFORD. — Hoffmann's Social Hall, 7.30 p.m. Chelmsford Engineering Society. "Silicones and their Applications in the Engineering Industry," by J. E. Monaghan and R. Howells.

DUNDEE.—Queen's College, 7 p.m. I.E.E. North Scotland Sub-Centre. "Colour Television," by Dr. G. N. Patchett.

GLASGOW.—39, Elmbank Crescent, 6.30 p.m. I.E.S. Glasgow Centre. "How I look at Lighting Engineering," by C. Stuart and L. C. Rettig.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. Ordinary meeting. "Some Aspects of Heat-Pump Operation in Great Britain, with particular reference to the Shinfield Installation," by Miriam V. Griffith.

Bonnington Hotel, Southampton Row, W.C.2, 6.30 p.m. Institute of Electricity Administration. "The Law Relating to Disconnection of Consumers' Supplies," by C. F. Weedon.

Manson House, Portland Place, W.1, 7 p.m. Society of Instrument Technology, Control Section. "Electronic Automation of Machine Tools," by F. T. Lett.

"Prince of Wales" Hotel, S.W.19, 8.30 p.m. A.S.E.E., South West London Branch. Branch lecturette: "Illumination," by C. F. Oliver.

NEWCASTLE-UPON-TYNE. — Carliol House, 3 p.m. E.I.B.A. Northern Counties Area. Annual general meeting.

Roadway House, Oxford Street, 7 p.m. Incorporated Plant Engineers, North East Branch. "Space Heating," by F. W. Watson.

SOUTHSEA.—Royal Beach Hotel, 8 p.m. A.S.E.E. Portsmouth Branch. "Further Thoughts on Application of Pyrotenax Cables in Buildings."

SWANSEA.—South Wales Electricity Board Showrooms, The Kingsway, 6 p.m. I.E.E. West Wales (Swansea) Sub-Centre. "The Instrumentation of a 14-Inch Experimental Rolling Mill," by S. S. Carlisle and G. W. Alderton.

WEMBLEY.—G.E.C. Sports Pavilion, Preston Road, 12.45 p.m. Institution of Works Managers, Wembley Sub-Branch. "Work Study," by F. E. Murray.

Friday, 11th January

BELFAST.—Grand Central Hotel, 7.30 p.m. I.E.E. Northern Ireland Centre. Annual dinner-dance.

BIRMINGHAM.—Queen's Hotel. I.E.S. Birmingham Centre. Annual dinner.

BRISTOL.—Grand Hotel, 8 p.m. A.S.E.E Bristol and West of England Branch. Lecture.

EDINBURGH. — Grosvenor Hotel. I.E.S. Edinburgh Centre. Annual supper and buffet dance.

The University, 7 p.m. British Institution of Radio Engineers, Scottish Section. "Potted Components and Assemblies," by H. G. Manfield.

STOKE.—Grand Hotel, Hanley, 7.30 p.m. A.S.E.E. Stoke & Crewe Branch. "Electronics in Industry," by E. Heys.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Bahrain. — Trucial-Coast Agricultural Development Scheme, British Residency. Electrically operated deep well pump. (E.S.B. 21241/56. Ten/23413.)*

Brecon.—County Council. 11th January. Electrical installation in Penman Boys' Technical Grammar School. (See this issue.)

Dundee.—North of Scotland Hydro-Electric Board. 31st January. Electrical goods and passenger lift for Carolina Port generating station. (See this issue.)

Formosa.—Central Trust of China, Purchasing Department. 14th January. Substation equipment including air break switches, disconnecting switches, air circuit-breakers, cables, etc. (E.S.B. 31563/56.I.C.A. Ten/23315.)*

Hatfield.—Herts County Council. 23rd January. Electric lamps for one year from 1st April, 1957. County purchasing officer, The Old Rectory.

India.—Government of Mysore. 14th January. 11 kV outdoor switchgear. (E.S.B. 32122/56. Ten/23427.)*

Iraq.—Ministry of Interior. 12th January. Two 100 kW generating sets. (E.S.B. 32085/56. Ten/23391.)* 19th January. Eight 50 kW or six 75 kW and four 100 kW diesel alternator sets. (E.S.B. 32086-7/56. Ten/23392-3.)*

Irish Republic.—Department of Posts and Telegraphs. 14th January. Electrical installation in the new post office, Galway. B. O. Mongain, secretary, Teach Liatdroma, The Castle, Dublin.

London.—Hackney Borough Council. 23rd January. Materials including street lighting equipment. (See this issue.)

Manchester.—South Manchester Hospital Management Committee invite applications from firms who wish to apply to be placed on the approved list of firms for maintenance and decorative works. (See this issue.)

Northern Ireland.—Belfast City Corporation. 25th January. Materials including electrical equipment. (See this issue.)

Prestwich.—Borough Council. 2nd February. Electric lamps and equipment for one year. Borough engineer, Town Hall.

Rhodesia and Nyasaland.—Federal Tender Board. 11th January. Twelve battery operated radio telephone-radio telegraph transmitter receivers. (E.S.B. 31597/56. Ten/23306.)*

St. Albans.—R.D.C. 19th January. Street lighting equipment. (See this issue.)

Sheffield.—No. 2 Hospital Management Committee. Applications are invited by 31st January for inclusion in a list of approved contractors for work including electrical repairs and renewals. (See this issue.)

South Africa.—Johannesburg City Council. 14th January. Electricity meters, current transformers and test blocks. (E.S.B. 32126/56. Ten/23418.)*

Stores Department, South African Railways. 18th January. Non-ferrous overhead track equipment. (E.S.B. 31585/56. Ten/23286.)*

Southampton.—Corporation. 25th January. Electrical installation in Redbridge Secondary School. (See this issue.)

Stourbridge.—Borough Council. 15th January. Starter batteries for the year ending 31st March, 1958. G. N. Maynard, borough engineer, Council House.

Swansea.—Borough Council. 25th January. Street lighting equipment for the year ending 31st March, 1958. Borough engineer, Guildhall.

Thailand.—Telephone Organisation of Thailand, Bangkok. 11th January. Telephone junction and terminal blocks. (E.S.B. 31338/56. Ten/23331.)* 18th January. Screws, angle screws, bridging sleeves, etc. (E.S.B. 31337/56. Ten/23340.)*

Uruguay.—Administración de las Obras Sanitariás del Estado. 21st February. Thirteen a.c. electric motors. (E.S.B. 31547/56. Ten/23317.)*

Wallasey.—Borough Council. 21st January. Electric lamps for the year ending 31st March, 1958. Borough engineer, Town Hall.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Newcastle-on-Tyne. — Education Committee. Electric lighting and power installation at West End Secondary Technical School for Boys (£13,665).—A. F. Jemison.

Seaford.—U.D.C. Supply and erection of 106 concrete lamp columns, 19 fluorescent lanterns and 89 sodium discharge lamps for Group "A" lighting scheme (£5,078).—Revo Electric Co.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Acton.—Factory, Western Avenue; Aircraft Steel Structures, Ltd., 7-17, Ansdell Street, London, W.8.

Bedford.—Office block; W. H. Allen, Sons & Co., Ltd., Queens Engineering Works.

Birmingham.—Dental hospital, corner of Loveday Street and St. Mary's Row; G. A. Phalp, secretary of United Birmingham Hospitals.

Bradford.—Industrial buildings on three-acre site at Moor Fairground; Crofts (Engineers), Ltd., Empire Works, Thornbury, Bradford.

Brandon.—Flats (34); surveyor, Brandon and Byshottles U.D.C.

Bristol.—Showrooms, offices, hotel annexe, multi-storey car park, and extension of existing premises, Clarence Road and Temple Gate; F. Alec French, architect, Halifax House, St. Augustine's Parade, Bristol, 1.

Houses (151), Kingsweston Lane (£441,710), for Housing Committee; Stone & Co. (Bristol), Ltd., 140, Redland Road, Bristol, 6.

Coventry.—Further instalment of College of Art and Technology, comprising buildings to house fine arts, textiles, mechanical engineering and electronics departments, on site near City Centre; A. G. Ling, city architect.

Crawley.—Factory and offices, Rutherford Way; Concrete & Structural Products, Ltd., 39, Brighton Road.

Crewe.—Rebuilding factory premises, Pym's Lane; Nash-Kelvinator, Ltd., 53, New Bond Street, London, W.1.

Croydon.—Factory in Purley Way; Siggs & Chapman, Ltd., Tithe Barn Works, Purley Way.

Durham.—Proposed Peterlee Dene House New County Junior School for the C.C.; A. Gilmore, Ltd., builders, St. Oswald's Drive, Durham.

Edmonton.—Additional factory; Zipp Fastener Co., Ltd., Angel Road, London, N.18.

Gatwick.—First stage of terminal buildings for new airport; Gilbert Ash, Ltd., builders, 2, Stanhope Gate, London, W.1.

Gosport.—Omnibus garage, North Street and Harbour Road; Hants & Dorset Motor Services, Ltd., 12, West Street, Fareham.

Grangemouth.—School in Kenilworth Street (£114,000); county architect, Viewforth, Stirling.

Hexham.—Houses (40) at North Wylam; W. Leech (Builders), Ltd., Clayton Street, Newcastle.

Liverpool.—Factory premises on Kitchen Street and Bridgewater Street sites; L. J. Gilchrist & Co., engineers and office fitters, 42, Hart Street.

London.—Office block, Wood Street, Staining Lane and Gresham Street, City; T. P. Bennett & Son, architects, 43, Bloomsbury Square, W.C.1.

Factory for G. & F. Holdsworth, Ltd., White Hart Road, Woolwich; W. J. Cearns, Ltd., builders, Carpenters Road, E.15.

Flats (64) on sites at Woolwich Road/Troughton Road and Devonshire Drive, Greenwich; H. Whetstone, town clerk, Greenwich High Road, Greenwich, S.E.10.

Extensions to Thames Refinery, Silvertown, E.16; Tate & Lyle, Ltd., sugar refiners, 21, Mincing Lane, E.C.3.

Offices, Snow Hill, Holborn; Theo. H. Birks, architect, 38, Portland Place, W.1.

Newburn.—Library; J. A. Weatherley, U.D.C. surveyor.

Houses (42) at Westerhope for the U.D.C.; R. Bowey and Son, builders, 34, Great North Road, Newcastle-on-Tyne.

North Shields.—Dwellings (54); Tasker & Partners, New Bridge Street, Newcastle.

Prudhoe (Northumberland). — Proposed babies' villa (£21,000) and sick hospital (£68,000) at Prudhoe and Monkton Hospital for Newcastle Hospital Board, Benfield Road, Newcastle-on-Tyne; P. H. Knighton, chief architect.

Rochdale.—Technical college; Yorke, Rosenberg and Mardall, architects, Hyde Park Place, London, W.2.

Rugby.—Technical school, Dunsmore Lane; W. H. Jones & Son, Ltd., builders, Lockhurst Lane, Coventry.

Sharston (Manchester).—Factory and offices in Shentonfield Road; Peter Cummings, architect, Oxford Street, Manchester, 1.

Stanley (Co. Durham).—Houses (100) at South Stanley; J. R. Heslop, surveyor.

Stockton-on-Tees.—Houses (128); C. M. Yuill, Ltd., Villiers Street, West Hartlepool.

Sunderland.—Houses (54); R.D.C. surveyor.

Showrooms, parking garage, and repairs establishment, High Street West, for Adams and Gibbon, Ltd., St. Thomas Street, Newcastle (£200,000); Wetherell and Lamb, architects, Picton Place, Newcastle-on-Tyne.

Secondary mixed school, Hylton Castle estate; borough architect, Grange House, Stockton Road, Sunderland.

Thornaby-on-Tees.—Houses (750); J. L. Watson, borough engineer.

Tynemouth.—Three-storey stores, Bedford Street, for George Swan, Ltd.; Mauchlen, Weightman & Elphick, architects, 12, Saville Row, Newcastle-on-Tyne.

Wakefield.—New factory building; British Ropes, Ltd. Denby Dale Road.

Watford.—Maisonnettes (24) and houses (32), Leavesden Green estate; Capital Homes, Ltd., 73, Acre Lane, London, S.W.2.

Worcester Park (Surrey).—Five blocks of flats, off Boscombe Road; Torlands Properties, Ltd., 2, Norfolk Street, London, W.C.2.